Radio, Electronics and Communications

FORMERLY "RADIO & ELECTRICAL REVIEW" — WIDELY KNOWN SINCE 1946 AS "R. & E."

MPL

In This Issue . . .

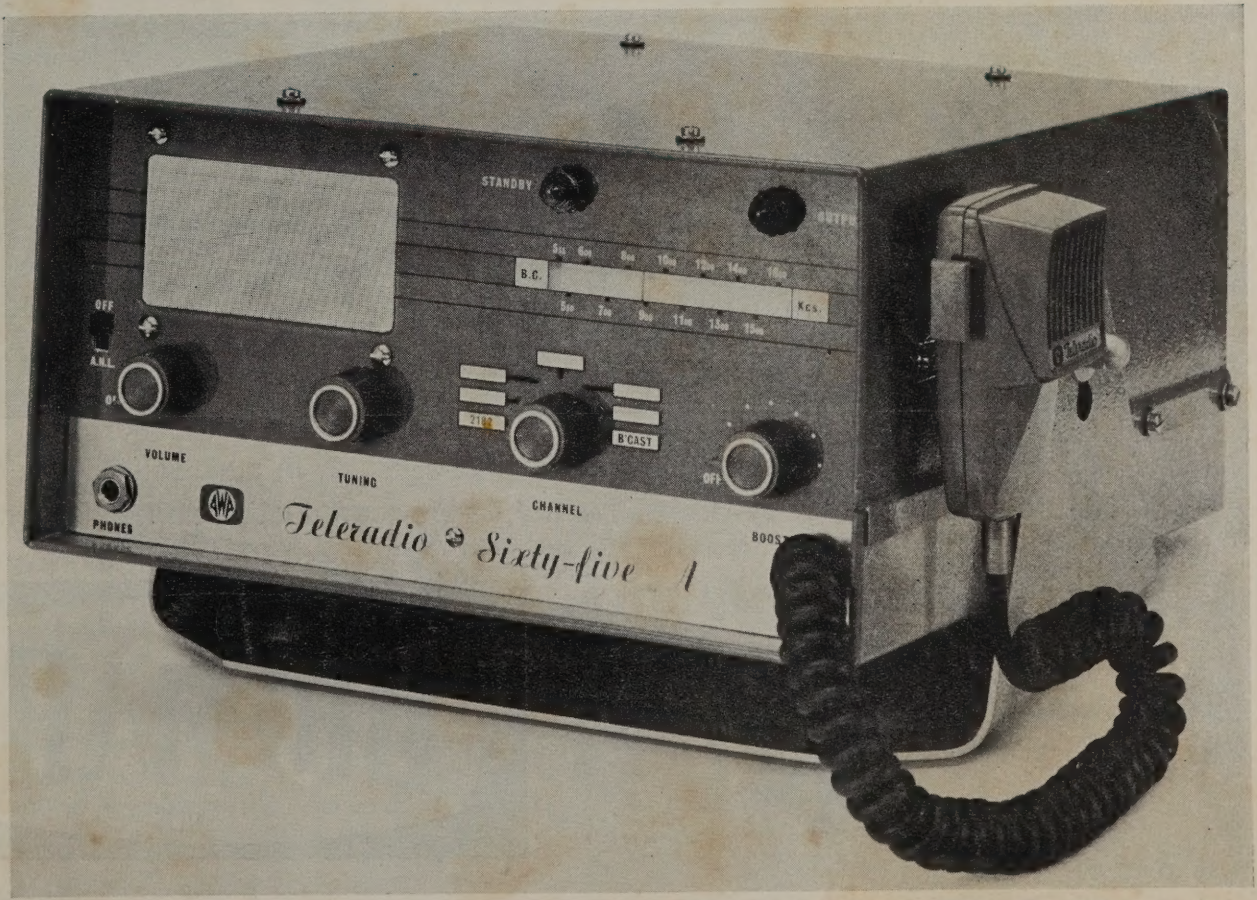
- New Telemetry System for Power Board.
- Accuracy of Electronic Digital Counters.
- Transistorised Hi-Fi Unit.
- Laboratory Report, Camera View.
- Mobile Communications.

SEPTEMBER 1, 1965

PUBLISHED MONTHLY IN THE INTERESTS OF THE N.Z. ELECTRONICS INDUSTRY FOR ALL LEVELS, FROM PROFESSIONAL TO AMATEUR.

VOLUME 20 NUMBER 7

PRICE 2/6



AWA EXPORTS QUALITY PRODUCT

ENQUIRY CARD AD. 1

Water lily and valve . . . beauty in pure lines and beauty in pure sound. One designed by Nature, and the other by Brimar for true-to-life reproduction and consistent reliability.

better rely on – **BRIMAR**

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Standard Telephones and Cables (Pty.) Limited AN ITT ASSOCIATE
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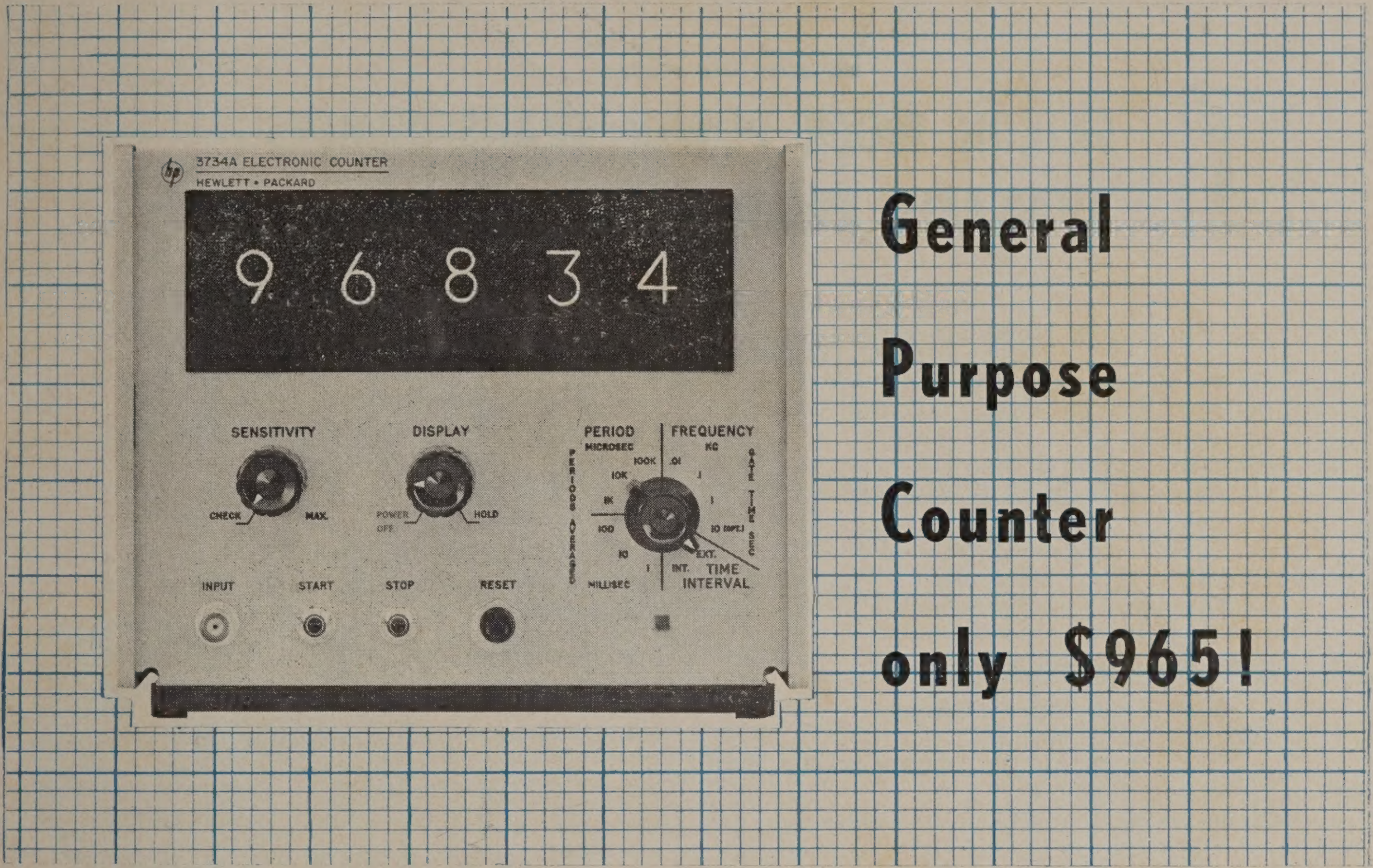
ENQUIRY CARD AD. 2



New compact, solid–state, 2 MHz electronic counter

Here's the new Hewlett–Packard Model 3734A Counter—only 8″ wide and 6″ high—ideal for bench use, yet easily rack mounted (with room for another modular hp instrument in a standard rack width).

Measure frequency ratio and multiple ratio
Make cumulative measurements

Measure frequency — 2 Hz to 2 MHz
Measure period and multiple period average

Measure time interval

With five–digit in–line readout, the 3734A displays any of these measurements in clear, easily read numerals. High sensitivity and a one–megohm input impedance assure accurate measurement of signals as low as 100 mv rms. The decimal is automatically positioned.

The internal time base is a stable 100 KHz oscillator—an external time base may be used if desired.

Display storage provides a continuous display of the most recent measurement, changing only when the count actually changes; a display control, adjustable 0·2 to 5 seconds, can be used to set the period of time between the end of one count and the start of the next. A reset disable function permits cumulative measurements.

Front–panel pushbuttons provide convenient manual control in time interval mode—for electrical operation there are separate start–stop inputs on the rear panel.

The size of the counter and a tilt stand provided for easy viewing make it ideal for bench use. At only 12½ pounds, it is excellent for portable applications. Price: hp 3734A, $965.

HEWLETT PACKARD hp *An extra measure of quality.*

PRICE SUBJECT TO CHANGE WITHOUT NOTICE. EQUIVALENT N.Z. PRICE AVAILABLE ON REQUEST

N.Z. AGENTS: **SAMPLE ELECTRONICS (N.Z.) LTD.**
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TELEPHONE 567-356

SERVICE AND CALIBRATION FACILITIES AVAILABLE

ENQUIRY CARD AD. 3

SILICON DIODE POWER TRANSFORMERS AVAILABLE FROM BEACON RADIO LTD.

R98 T.V. POWER TRANSFORMER

For R.T.V. & H. 1959 and later T.V. Sets. Delivers 260v @ 300mA D.C. Full wave voltage doubler.
230:115v A.C. @ 300mA D.C.
:12.6v C.T. @ 5A (2 windings ea. 6.3 @ 5A).
:0—6.3—7.5—9 @ .6A. Picture tube winding.
Choke:—C36. Use 400v P.I.V. Diodes.

R103 Stereo Power Transformer

R.T.V. & H. Aug. 60. 7w Stereo.
230:245v @ 150mA. D.C.
:104v @ 150mA D.C. Voltage doubler Rect.
:6.3v C.T. @ 5A.
Choke:—C42. Use 400v P.I.V. Diodes.

R104 Stereo Power Transformer. 10w

320v @ 320mA. Voltage doubler Rect.
230:130v @ 320mA.
:6.3v @ 6A.
Choke:—C49. Use 500v P.I.V. Diodes.

R105 T.V. Power Transformer For Philips T.V. Kitsets

220v @ 420mA D.C. Voltage Doubler Rect.
230:106v @ 420mA D.C.
:6.3v @ 10A.
:0—6.3—7.5—9 Ov @ 0.3A. Picture tube Winding.
Choke:—C45. Use 400v P.I.V. Diodes.

R106 T.V. Power Transformer for Philips T.V. Kitsets

This type similar to R105 but less Picture Tube boost taps. Main Fils. 12.6v C.T. @ 5A.
220v @ 420mA D.C. Voltage Doubler Rect.
230:106v @ 420mA D.C.
:12.6v C.T. @ 5A (2 windings 6.30v @ 5A each).
:6.3v @ .3A Picture tube winding.
Choke:—C45. Use 400v P.I.V. Diodes.

R108 Small Stereo Headphone Power Transformer

250v @ 22mA D.C.
230:110v @ 22mA D.C. Voltage doubler Rect.
:6.3 @ 0.86A.
Choke:—C41. Use 400v P.I.V. Diodes.

R110 T.V. Power Transformer. For Philips T.V. Kitsets

This transformer uses full wave bridge rectifier. Requires no limiting resistor unlike equivalent voltage double types, also has advantage of no insulated capacitor and lower ripple output with smaller choke.
Output 220v @ 420mA D.C.
230:172v @ 420mA D.C. Full wave bridge Rect:
:12.6v C.T. @ 5A (2 only 6.3v winding @ 5A).
:6.3v @ .3A Picture tube winding.
Choke:—C50. Use 400v P.I.V. Diodes.

R111 T.V. Power Transformer

Similar to R110 but for R.C.A. type Kitsets.
260v @ 350mA from Rect.
230:207v @ 350mA D.C. Full wave bridge Rect.
:12.6v C.T. @ 5A (2 only 6.3v windings each 5A).
:6.3v @ 0.6A. Picture tube winding.
Choke:—C42. Use 400v P.I.V. Diodes.

R112 Oscilloscope Power Transformer

R.T.V. & H. 1963. Calibrated.
230:110v @ 80mA D.C. Full wave voltage doubler.
:6.3v @ 2.4A.
:6.3v @ 1A.
:6.3v @ 1A.
Use 400v P.I.V. Diodes.

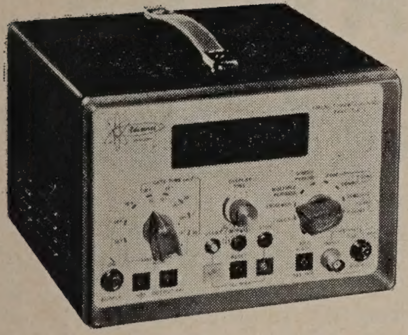
BEACON RADIO LIMITED

Corner Brown and Fitzroy Sts., Ponsonby, Auckland. P.O. Box 2757. Telephone 16-164 (3 lines)

ENQUIRY CARD AD. 4

Advance timer counters

TC2



1Mc/s Timer Counter

Display Four edge-lit in-line indicators with ¾ × ⅝in numerals with decimal points. *Accuracy* ± one count ± accuracy of standard. *Display resetting* Automatic, manual or by positive pulses. *Frequency measurement* Range 0 to at least 1Mc/s. *Gate times* 0·001, 0·01, 0·1, 1 and 10s. Decimal point automatically positioned for display in kc/s. *Sensitivity* Normal input 10c/s to 1Mc/s. Sinusoidal signal between 200mV and 250V r.m.s. Non-sinusoidal signal not greater than 400V pk. V.L.F. input 0 to 10kc/s. Signals between +2 and +50V pk. *Input impedance* Normal input 100kΩ shunted by 30pF. V.L.F. input 5kΩ approx. *Time measurement* 3μs to 10^5s. *Period measurement* From 1 to 10^5 periods. *Counting* 1 to 9999 regular or random pulses. *Frequency standard* INTERNAL 1Mc/s crystal oscillator, oven controlled at 65°C. Accuracy 1 part in 10^6 at 25°C ambient. ±5 parts in 10^6 from 0 to 35°C. EXTERNAL Any sinusoidal signal between 1kc/s and 1Mc/s of amplitude between 1 and 10V r.m.s. or suitable pulse signal. External gate control available. *Check* Self-checking facilities incorporated. *Operating temperature range* 0 to 35°C ambient. *Power requirements* 100 to 125V or 200 to 250V, 45 to 100c/s, 35W. *Dimensions* 8½in (22cm) wide × 6in (15cm) high × 7½in (19cm) deep. *Weight* 12½lb (5·7kg).

TC10

10Mc/s Transistorised Timer Counter

Display Eight edge-lit indicators (7 digits + caption) with automatically positioned decimal point. *Accuracy* ±1 count ± accuracy of standard. *Display resetting* Manual, automatic or pulse. *Frequency measurement* Range 0 to at least 10Mc/s. *Gate times* 0·1, 1·0 or 10s with caption and decimal point; 0·01 and 0·001 without. *Sensitivity* High impedance (10c/s to 10Mc/s) 100mV to 250V r.m.s. or non-sinusoidal inputs up to 400V pk. Low impedance (10c/s to 10Mc/s) 100mV to 6V r.m.s. into 50/75Ω. V.L.F. (0 to 10kc/s) 2V to 50V into 5kΩ. *Time measurement* From 0·5μs to 10^8s. *Period measurement* 1, 10, 10^2, 10^3, 10^4 or 10^5 cycles of the input waveform with 10^7 p.p.s. timing. *Counting* 1 to 9999999 totalling over any period. *Frequency standard* INTERNAL 5Mc/s crystal oscillator HCD15 oven controlled at +50°C. Accuracy ±2 parts in 10 over the range 0 to 45°C. EXTERNAL Any sinusoidal signal from 1kc/s to 1Mc/s of amplitude between 1V and 10V r.m.s. or suitable pulse signal. *Check* Self-checking facilities incorporated. *Operating temperature range* 0 to 40°C (ambient). *Power requirements* 90 to 130 V and 200 to 240V, single phase. 40 to 100c/s, 40W. *Dimensions* 18in (45·7cm) wide × 13in (33cm) high × 11in (28cm) deep. *Weight* 35lb (15·9kg).

ADVANCE ELECTRONICS LIMITED ENGLAND

Sole New Zealand Representatives

TURNBULL & JONES LTD.

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FROM THE COMPREHENSIVE RANGE OF Advance INSTRUMENTS AND EQUIPMENT

ENQUIRY CARD AD. 5

HIGH POWER OUTPUT LOW INCIDENTAL FM & DRIFT

VHF SIGNAL GENERATORS 608C & 608D

Eleven years of successful marketing prove the highly refined circuitry. Mechanical ruggedness results from the use of cast aluminium screening boxes for both the oscillator and tuned amplifier. Low temperature coefficient materials ensure high frequency stability. Split stator capacitors having no sliding contacts ensure electrical stability. Regulated heater and H.T. supplies maintain the validity of the specifications for ± 10% mains voltage changes.

FREQUENCY SPECIFICATIONS	HIGH POWER OUTPUT	LOW INCIDENTAL F.M.	BROAD MODULATION CAPABILITIES INTERNAL
RANGE 608C - 10Mc/s to 480Mc/s 608D - 10Mc/s to 420Mc/s ACCURACY 608C - ± 1% 608D - ± 0.5% The Crystal calibrator in the 608D gives 0.01% accuracy at the 1Mc/s cardinal points, and 0.1% accuracy on the venier dial. STABILITY "Invar" used for the capacitor plates and coils contributes to the achievement of a low drift rate of 0.005% per 10 minutes.	LEVEL 608C - 0.1μV to 1.0V into 50 ohms. 608D - 0.1μV to 0.5V into 50 ohms. ACCURACY ± 1db over the entire frequency range from the piston attenuator calibrated in volts and dB's; into 50Ω load.	608C - A master oscillator power amplifier circuit keeps incidental F.M. below 3 parts in 10^5 at 30% amplitude modulation. 608D - Refinement of the 608C circuitry results in incidental F.M. below 1 part in 10^5 at 50% amplitude modulation. Especially suited for precise tests of narrow band V.H.F. equipment.	400 c/s and 1,000 c/s sinewave. EXTERNAL 20c/s to 20Kc/s amplitude modulation. High modulation sensitivity of 0.5 V for 95% modulation. Pulse Modulation — 40Mc/s to 220Mc/s for pulse widths of 4μsec and above. 220Mc/s to 420Mc/s for pulse widths 1μsec and above. ENVELOPE DISTORTION Less than 5% at 30% sinewave modulation.

HEWLETT hp PACKARD

An extra measure of quality

PRICES	608C $1200	608D $1300

NEW ZEALAND PRICES AVAILABLE UPON REQUEST

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* * *

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Vol. 20, No. 7 September 1, 1965

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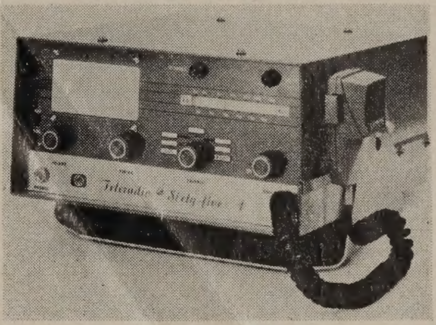
On Our Cover



Our front cover shows one of the latest generation of HF Marine Teleradios designed and developed by AWA's New Zealand engineers to meet the stringent specifications laid down by the New Zealand Post Office in their Specification, June 1963.

An order for 50 sets has just been completed for Australia, 9 sets are on the way to India, and numerous small orders are in hand for Fiji and the Pacific Island territories.

The performance of the sets is excellent and the quality of construction is of the highest international standard.

As it is not possible for a factory to survive on export orders alone, AWA are expecting their Teleradio 65A to enjoy substantial sales in New Zealand also.

COMING . . .

Special Marine Electronics Issue including —
F.M./V.H.F.
R/Telephones
Radar
Converters
Fish-Finding & Flow Measurements
Beacons, Shore Stations — frequencies and geographical locations

Also . . .

New TV Kitset—a review
Hi-Fi Amplifier
—concluding section
V.L.F. Radio Propagation
Mobile Communications

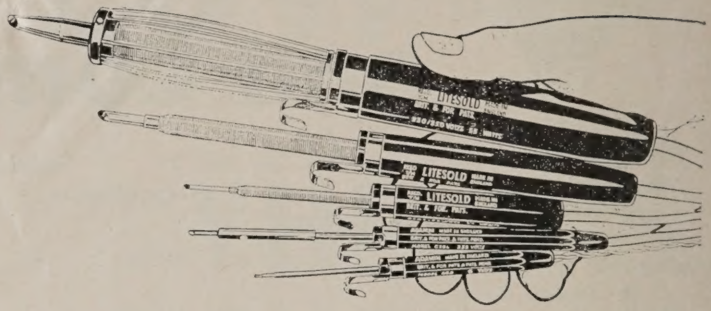
ENQUIRY CARD AD. 7

YOUR **SOLDERING IRON** REQUIREMENTS

THE WIDELY KNOWN

LITESOLD

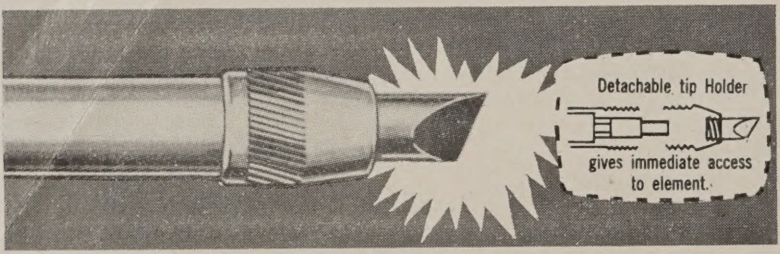
MODELS



Model 610	10 Watt	3/32″ Bit
Model 630	25 Watt	3/16″ Bit
Model 640	30 Watt	1/4″ Bit
Model 650	35 Watt	5/16″ Bit
Model 670	55 Watt	13/32″ Bit

- **ALL FEATURE REPLACEABLE BITS**
- **LIGHTWEIGHT WITH HIGH EFFICIENCY**
- **HANDLES NON-CONDUCTIVE TO HEAT**

Litesold Soldering Irons are developed and designed by LIGHT SOLDERING DEVELOPMENTS LTD, ENGLAND. Specialists in soldering iron manufacture for over 25 years.



TO COMPLETE THE RANGE

BIRKO

IRONS

PRESS-BAR HEAT with the BIRKO INSTANT HEAT

D11	Instant Heat		D2	200 Watt	1/2 to 1″ Bit
D9	40 Watt	3/16″ Bit	D4	250 Watt	3/4 to 1″ Bit
D8	60 Watt	3/8″ Bit	D5	300 Watt	3/4 to 1″ Bit
D1	80 Watt	1/2″ Bit	D6	350 Watt	3/4 to 1¼ Bit
D3	130 Watt	3/4″ Bit	D7	400 Watt	3/4 to 1¼ Bit

A model for every purpose, from light radio and model work to heavy cannister, and plumbing requirements. A full range of bits, elements, heat guards and spares readily available through all the leading wholesalers.

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DAVID J. REID (N.Z.) LTD., AUCKLAND

Letters from Readers

Dear Sir,

The June 1964 issue of your Magazine "Radio, Electronics and Communications" carried an article on VHF Mobile operation. The article also contained a circuit of a 2 metre Receiver. At the end of the article it was stated that a further article would appear the following month, and that this would have a more sophisticated version of the Receiver. The article mentioned did not appear in the July 1964 issue, and I would appreciate it if you would be able to forward me a copy of the issue in which it did appear.

I did notice that the **July** 1964 issue mentioned that the following month's magazine would feature an article on "some aspects of VHF Mobile operation." It is possible that this is the article referred to.

The same July issue also mentioned that an article on "an unusual Grid Dip Oscillator" would appear in the August issue.

Yours faithfully,
G. CLARKE, VK2ZXD.
Sydney, Australia.

We are pleased to have been able to forward you copies of these articles from August and September issues.—Ed.

The Editor Reflects

Magazine publishing is, in one way, akin to bullfighting — both fields have their own moment of truth. Our moment of truth is when we examine those first copies rushed from the bindery. The editoral department skims through its copy, the advertising boffins do likewise. Rather apprehensively the pages are flipped — are the pages in order? Are the illustrations the right way up? Are there any spelling mistakes? Mistakes have a peculiar way of leaping off a printed page and screaming for attention. Our August issue featured mistakes in, horrors of horrors, an advertising page. The 241A Oscillator has 4,500 discrete frequencies not 4,5000. The calibration accuracy is ±1% and the frequency response is ±2% into rated load.

Due to a mix-up in communications with California another error was printed in the Sample Electronics (NZ.) Ltd advertisement on page 4, August issue. The portable voltmeter has a range of .0001 to 300 v RMS full scale, 12 ranges.

We apolgise. However you may be sure that the advertising staff have been suitably chastised; their subscriptions to Playboy will not be renewed.

Radio Mr Serviceman

ENQUIRY CARD 9

Our radio broadcast universal replacement coils will replace any damaged aerial, R.F. or oscillator coil. Designed to assist you in maintaining first-class service to your clients.

Aerial Type 40
R.F. Type 45
Osc. Type 41

Write for alignment procedure Sheet № 5/40

New factory address:
Cameron Rd. South, Greerton, Tauranga

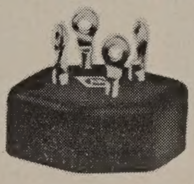
Inductance Specialists LTD. See page 29

ENQUIRY CARD AD. 8

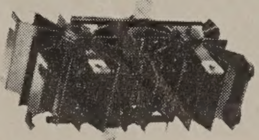
MOTOROLA

LOW PRICES FOR CURRENT SEMICONDUCTORS

Intergrated circuits • Multiple devices • High-frequency amplifier transistors • Microwave products • High-frequency switching transistors (Germanium and Silicon) • Field effect transistors • Germanium milliwatt transistors • Power transistors (Silicon and Germanium) • Silicon controlled rectifiers • Gate controlled switches • Four-layer diodes • Unijunction transistors • Zener Diodes • Reference Diodes • Silicon Rectifiers • Circuit Assemblies • Military-Type devices.



BRIDGE ASSY.



RECTIFIER STACK

Motorola's new Silicon R. F. Power Transistors offers up to 20 watts output at 50 m.c.

Motorola's new team of Silicon High-power, high-frequency R.F. power transistors are available from Elekon (Overseas) Ltd.

Designed to operate at low supply voltages (12 to 25 volts) there devices are ideal for portable equipment in the field.

NEW FIELD EFFECT TRANSISTORS

MM 2090 35/– each
MM 2091 45/– each
MM 2092 55/– each

Elekon welcome enquires for design information as they maintain a large file of application reports for Motorola semiconductors. Motorola semiconductors are available for every purpose and in unlimited variations.

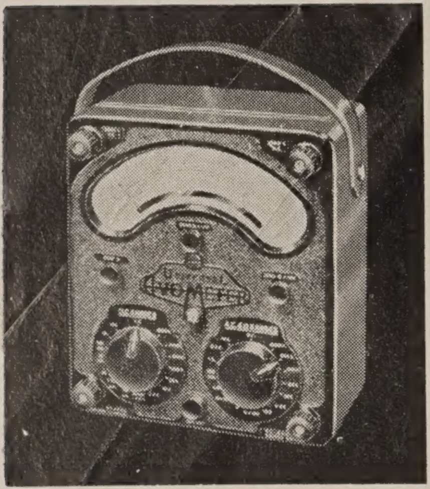
Elekon (Overseas Ltd., are sole New Zealand agents for Motorola semiconductors and Communications equipment.

ELEKON
(OVERSEAS) LTD.

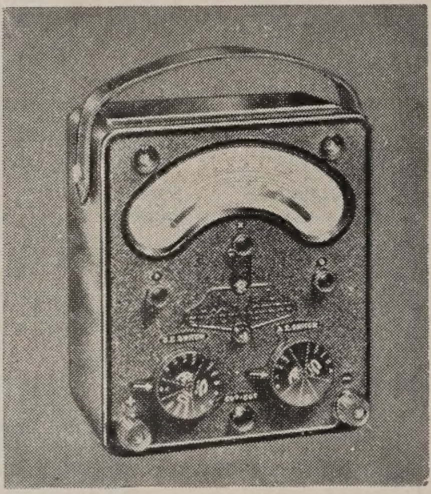
P.O. BOX 5146 AUCKLAND. PHONE 16-189

ENQUIRY CARD AD. 10

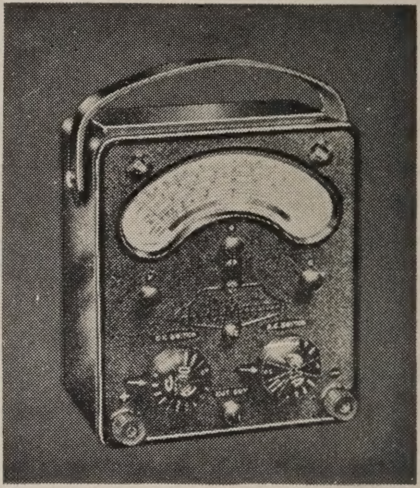
Accurate, sensitive, dependable
Measuring Instruments



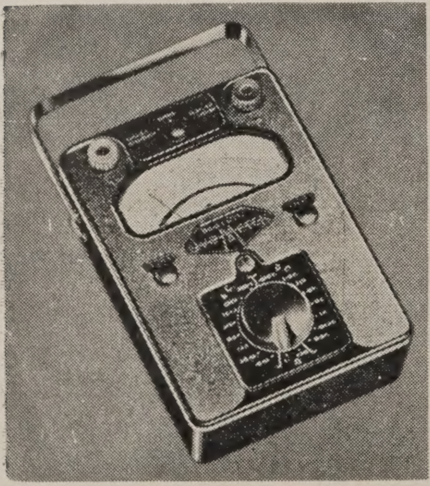
Model 8 Mk III universal AvoMeter
Specially designed for electronic, radio and television engineers. Sensitivity of d.c. 20,000 ohms per volt and a.c. 1,000 ohms per volt from the 100V range upwards. Simple to operate, compact and portable



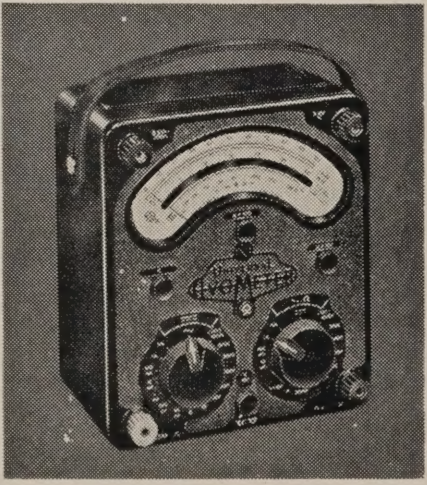
Model 7 universal AvoMeter
This 50 range ac./d.c. moving coil instrument is fitted with a 5 inch hand calibrated scale, incorporating an anti-parallax mirror. Its accuracy enables it to be used for measuring audio-frequencies.



Model 40 universal AvoMeter
A 40-range a.c./d.c. moving coil instrument designed around a 3mA d.c. movement for the heavy electrical engineer. An automatic overload cut-out device is incorporated to safeguard the instrument against misuse



Heavy Duty AvoMeter Mk V
An 18 range instrument specially designed for use under difficult conditions, such as outdoors, where a portable instrument of strong construction is needed. Sensitivity: d.c. 1,000 ohms per volt: a.c. 500 ohms per volt, except on the 10V a.c. range, which is 200 ohms per volt.



Model 9 Mk II AvoMeter
Recommended for Television engineers, this multimeter is essentially the same as the popular Model 8 Mk III, but differs in the following points . . . both the a.c. and the d.c. voltage ranges go up to 3000V. All ranges are identified with graphical symbols, which follow the I.E.C. (International Electrical Committee) recommendation.

The Multiminor Mk IV
A well made simple to use pocket size instrument. Ranges: a.c. voltage 10 to 1,000 volts: d.c. voltage 100mV to 1,000 volts: d.c. current 100uA to 1A.

There is also a full range of AVO Precision and Test Instruments.

A 1.5

NEECO WHOLESALERS LIMITED

ENQUIRY CARD AD. 11

NO SHIELD

Direct Vision is, in fact, an entirely new concept in picture tube design. It is a practical application of the principle of integral protection, the outcome of years of original research.

Direct Vision eliminates the need for any protective shield so that a constantly brighter and sharper picture is obtained. This is due to freedom from multiple reflections which spoil contrast, and freedom from inaccessible dust on the tube face.

Because of its special construction the tube can be handled with complete confidence.

The integral mounting lugs, another outstanding feature of the tube, offer great simplification both in the manufacture and servicing of television receivers. More than this Direct Vision opens up new possibilities in set styling. Its favourable weight distribution ensures utmost set-stability, which is of special importance with a view to advanced designs.

PHILIPS

VISION direct

the most advanced picture tube in the world

ENQUIRY CARD AD. 12

PACEMAKER PRESENTS

MODEL MA3 AMPLIFIER

A full technical description of the PACEMAKER MODEL MA 3 AMPLIFIER appears on page 27 of this magazine. Ask your dealer for a demonstration.

only £18/18/0 retail

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AUCKLAND WELLINGTON CHRISTCHURCH DUNEDIN
NELSON OAMARU INVERCARGILL

DESIGN AND NEEDS

Shortly we will be publishing a series of articles dealing with the philosophy of logical design procedures. By way of preparation, and to emphasise that not all design is logical, we have given some thought lately to the problem to audio amplifiers and their design: Not so much on how to design a specific circuit but on matching the user needs to a design form.

Fortunately, in New Zealand we have not yet reached the stage of planned redundancy, so much an integral part of the American economy — but we are drifting into the traps planted by the advertising experts — the wordsmiths — both overseas and here, in that fashionable ideas are followed with not much thought to the real need for them.

There is little doubt that transistor amplifiers have considerable technical advantages over their valve counterparts; apart from marginal weight and size reductions in the middle power range (20 watts per channel, say), the distinct external advantages include less heat dissipation and greater power economy. From the listening point of view, the critical ear will discern better transient response and damping in transformerless output types.

In lower power ranges usually the advantage lies with transistor amplifiers in all respects except price and for the higher powers, say 50 watts, the price of transistor amplifiers is outweighed by the reduction in size, heat and weight. However, these assumptions are usually only valid when peak performance is required and it seems as if standard grade performance cannot be obtained at reasonable prices. To want, and to accept, an amplifier with distortion percentages up around the 2% or 3%, immediately puts one into technical coventry.

Recently, when on the search for a stereo amplifier, we were subject to the kind of pressure that is probably a part of daily sales routine. First, there was a salesman's version of the design procedure in the maker's factory — the wide survey taken of the needs of hundreds of American homes — the years (?) on the drawing board — the very latest components used (not quite tying up with the years of research and the months between trial samples tried by famous musicians and the final production models just arrived in New Zealand). Then, the usual soft soap about keeping up with the Jones' but finally the thrill of "this was designed for **your** home." To the question of how or why we learned that the size and weight were just right. To put things in perspective, two American amplifiers of about the same power were examined and tested. One was 1" wider than its companion, exactly the same height and depth, from the same maker and, on paper, almost identical performance figures applied. The price was £62 against £103 for the more elegant version.

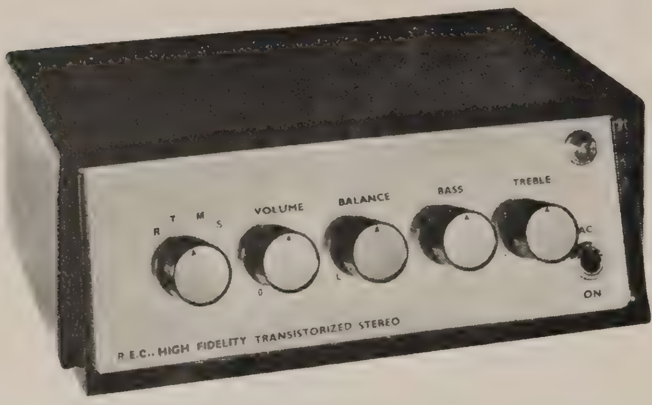
What overseas firms do is very much their own business, but when the same trends show up in the New Zealand electronic industry we feel this is our business. At present, hi-fi amplifier production is just getting under way in this country; but our quick shopping expedition (incidentally, conducted in three cities) showed a tendency towards local manufacture on a "fashion" basis. It also showed that prices followed the fashion houses' trend — upwards.

Whilst we have not had the opportunity to examine very many amplifier circuits, it does appear as if some local designs are not shaped towards the need or end use. This applies to both valve and transistor types. Otherwise good performance ruined by poor tone controls or bad filtering ruining power output are two examples. Another local example is the use of an extremely smart — and expensive — panel on a very moderate performance equipment intended for dance-band use.

Smart appearance and contoured lines are essential for domestic equipment, but have little place in equipment moved from place to place and subject to hard use. Similarly, not all audio equipment needs to be "that" small. Certainly some does, but the exact need and its extent should be examined before development is undertaken. The need is part of the design and should be, perhaps, the step that is given the greatest consideration — it could well turn out that there is no real need, despite the pretty design and elegant circuitry. Better to examine the need first and the techniques later.

The economy of New Zealand is vastly different from that of America. The point we wish to make here is that their sales methods and "inflation" in design and production procedures must be avoided in New Zealand if the best use of men and materials is to be made. This philosophy we will expand in the forthcoming articles on design.

C. W. S.



A Transistorised Stereo Amplifier System

by Irving Spackman, A.M.I.E.E.E.

Photography: Barry McKay Industrial Photography Ltd.

During the last few years, it has become obvious that the day of the all transistorised high quality or "hi-fi" amplifier is near at hand. Transistors are attractive for audio use, because, in general they greatly ease problems of hum pickup, microphony, and heat, and these factors coupled with the current use of transformerless output circuits produce further advantages in small size, weight, wider frequency response, greater efficiency, lower distortion without feedback, and a greater amount of negative feedback, which can be used before instability occurs.

In addition, dispensing with the relatively expensive output transformers offers an overall saving in cost, even though the cost of the transistors is about 50 per cent more than the cost of valves used in designs capable of similar performance.

In the system to be described, we have incorporated two channels, each capable of 8-10 watts output, together with all normal control functions in a case which normally would only just cope with the pre-amplifier control unit of a conventional two unit "hi-fi" system.

The first real application of transistors in high quality domestic audio systems was demonstrated when C. H. C. Lin, in the September 1955 issue of the journal "Electronics" described a circuit to give six watts output from a single-ended, push-pull pair of P.N.P. power transistors driven by a N.P.N. and a P.N.P. transistor complementary pair of low power transistors, operating as a driver and phase inverter.

Despite this lead, high power transformerless transistorised audio circuits were not very common until the early 1960s when various designs were produced by workers in America, Gt. Britain and the Continent. These generally used the then current favourites, in low frequency germanium power transistors. Much more activity has followed and early this year, R.C.A. released a circuit designed around a new range of domestic priced high frequency silicon N.P.N. transistors.

This range has just become available in New Zealand, and we were fortunate enough to be able to get some samples in sufficient time so that the basic

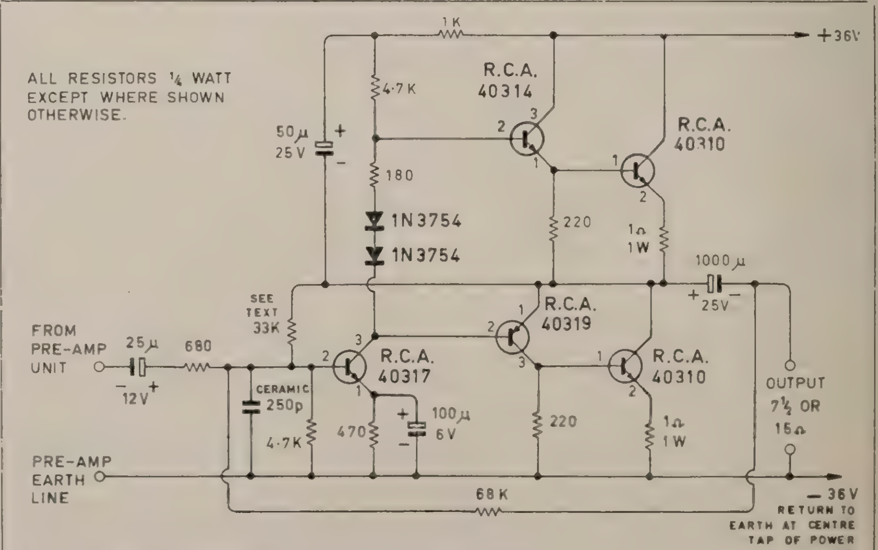
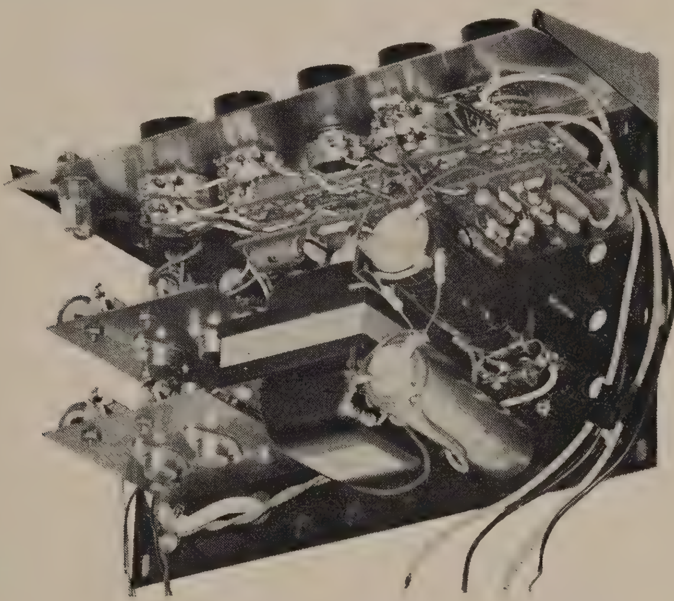


FIG. 1 ONE CHANNEL OF STEREO AMPLIFIER.

circuit could be tried out. Results were extremely satisfying, and accordingly, we intend, in this and a later article, to present the basic circuit together with various types of pre-amplifier circuits to suit different applications.

Let us now turn to the circuit of the main amplifier, and consider the operation of the three main sections. We have only shown full details of one channel, but other points are included where two channels must be integrated to form a stereo pair.



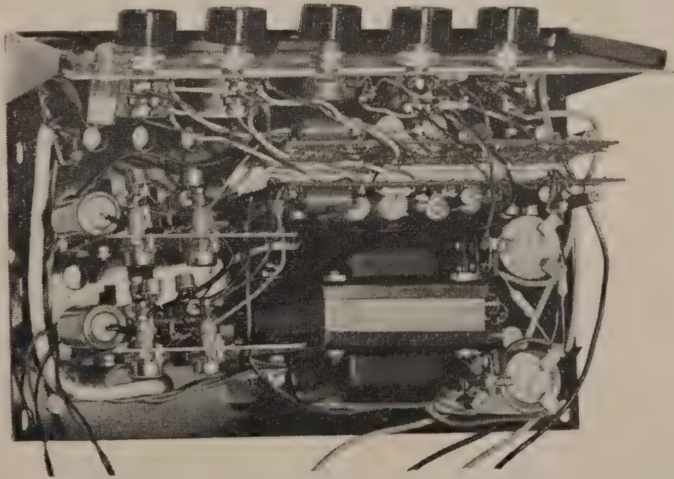
An interior view showing physical layout and relationship of components and sections.

The input stage, using R.C.A. Transistor type 40317 is a low level Class A common-emitter amplifier, running at about 2 mA collector current. This operates as a directly coupled driver stage for a complementary-symmetry P.N.P.-N.P.N. pair consisting of R.C.A. types 40319 and 40314 respectively. These latter two transistors form a "Class B" phase-inverter and driver for the output pair to which they are directly coupled. At this stage, it is perhaps interesting to note that the 40314 and 40317, which are N.P.N. transistors, and the 40319 which is a P.N.P. complement to the 40314, all have peak collector current ability of 0.7 amp. a dissipation of 1 watt in a T05 case and gain-bandwidth products f_T of typically 100 mc/s. The 40314 and 40319 have typical B figures of between 35 and 200 with collector current of 50mA. The 40310 N.P.N. output transistor has a typical f_T of 750kc. operating at $\frac{1}{2}$ amp. collector current in a grounded emitter, and under these conditions exhibits B figures of between 20 and 120. It is encapsulated in the new T066 case with a dissipation of 20w. up to 75°C. It is mainly on account of the high frequency performance figures that these new transistors operate so well in this amplifier.

Considering now the phase inverter system, as a first approximation, the bases of the 40319 and the 40314 can be regarded as being connected together, since the two forward biassed IN3754 diodes and the 180 ohm series resistor in total still amount to a low resistance.

Consider at this point the 40314 and its associated 40310 as a direct coupled pair, similarly the 40319 with its coupled 40310. If a sinewave signal is applied to the parallel base connections of the 40314 and 40319, then the two upper transistors conduct during the positive half cycle, whilst the two lower transistors conduct during the negative half cycle. When the upper transistors conduct the emitter voltage of the upper 40310 closely follows the base input voltage of the 40314 by emitter-follower action. Thus the input current to the 40314 is amplified by both upper transistors to give an output current into the load RL of β (40314) x β (40310) times this input current.

Similarly, when the two lower transistors (40319, 40310) conduct on negative half cycles, the emitter voltage of the 40319 (the output connection) closely follows the base voltage, and the output current from the 40310 collector is β (40319) x β (40310) times this input current. The input resistances at the bases of the 40314 and the 40319 during conduction half cycles of the input signal are β (40314) x β (40310) x RL, and β (40319) x β (40310) x RL respectively. If the product of the βs of the upper and lower pairs are equal, the input resistances are equal and the compound output circuit is balanced. The output is taken from the central common line between the top and bottom pairs via a large value capacitor to feed the loudspeaker.



A further illustration showing the details from a different angle.

Drive to the bases of the 40314 and 40319 is provided by the 40317 via the 4.7k. ohm load resistor. This resistor could have been connected directly to the positive line, but the pairs of transistors operating as compound emitter-followers have such high input impedances that that small value of load would have shunted most of the available signal current. The effective resistance of the 4.7k. ohm load is increased many times in this circuit by including a "bootstrap" circuit consisting of a 1k. ohm resistor and a 50 mfd. capacitor to the top end of the driver load resistance.

It will be noted that except for the input and output coupling capacities, the remainder of the circuit is directly coupled. This means that the bias voltage on the base of the 40317 must be adjusted (by adjusting the value of the 33k. ohm resistance if necessary) to bring the voltage at the centre line of the amplifier under "no-signal" conditions to near to half the supply voltage.

In all amplifiers so far constructed by the author, the value of 33K. has not required alteration.

The Use of Class B in High Quality Power Amplifiers

With no signal applied, the quiescent dissipation in the output stage of this amplifier is less than 1 watt. This means that much smaller heat sinks are required, than would be needed say if the output pair operated in a "Class AB" mode, with its correspondingly higher dissipation.

It is believed by some that "Class B" operation is not capable of high quality performance because of the possibility of cross-over and third harmonic distortion.

This has been refuted by many workers for a number of reasons. With the transformerless semi-complementary circuits and direct coupling, the ability to use large amounts of negative feedback results in low distortion levels. Other factors such as optimum bias conditions, and variations of bias with temperature, which are very important in amplifiers using germanium power transistors assume very small proportions when silicon transistors are used with their inherent insensitivity to normal changes in ambient temperature. With the D.C. feedback employed in this circuit quiescent current stability is excellent up to temperatures approaching 70°C. In addition, any variations in the standing current through the output stages with temperature is reduced due to the presence of the two forward biased diodes in the chain between the bases of the phase inverter pair. In practice, when this amplifier is operating in a domestic system, providing normal listening level, there is no indication of any transistor heating, with the transistors appearing "cold to the touch".

There is one point in which caution should be exercised however; if the load of this amplifier is accidentally shorted out while the amplifier was operating at high levels, then damage to the output transistors could occur.

The Preamplifier

The preamplifier included in the unit being described is designed to be fed from one of 3 different programme sources. These are (1) Radio Tuner; (2) Tape replay from a preamplifier

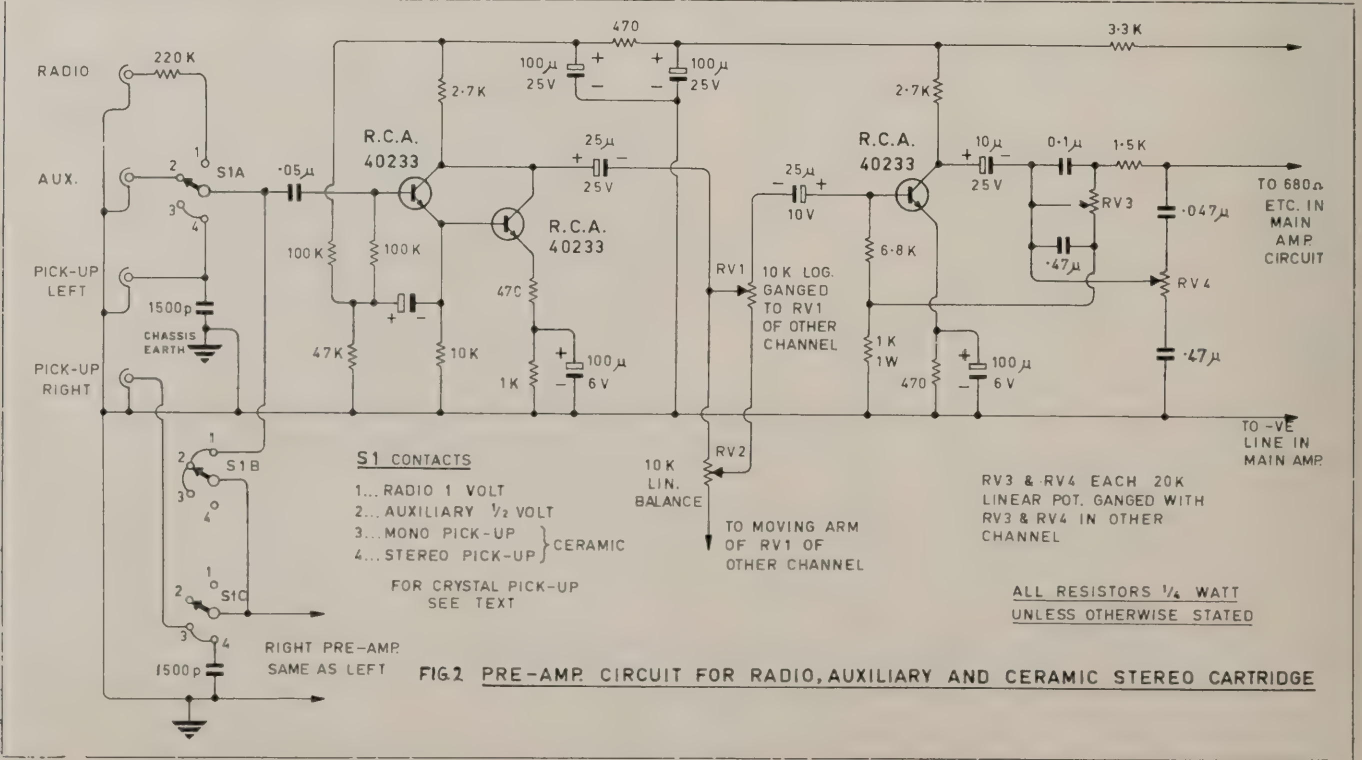


FIG.2 PRE-AMP. CIRCUIT FOR RADIO, AUXILIARY AND CERAMIC STEREO CARTRIDGE

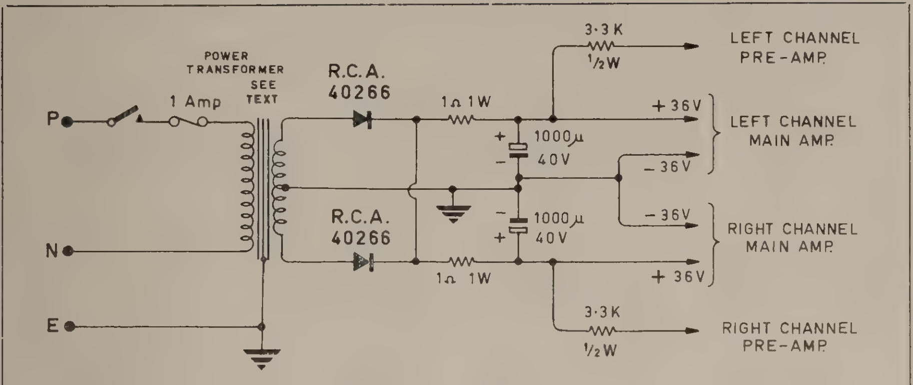


FIG.3 POWER UNIT FOR BOTH CHANNELS.

in a monaural tape recorder, and (3) a "Stereo" ceramic cartridge, with facilities for playing "mono." or "stereo." records. The input sensitivities for these three sources, measured for full output at 1000 c/s with volume control fully advanced, and tone controls in the flat position are (1) Radio 250 mv. across 1 megohm, (2) Tape 125 mv. across ½ megohm, (3) monaural pickup 400 mv. across ¼ megohm, (4) stereo pickup 250 mv. across ½ megohm for each channel.

Readers will notice that when the input is being fed from a ceramic or crystal pickup cartridge, that a shunt capacity is connected across the input to provide the correct input time constant. As this capacity acts with the capacity of the pickup cartridge to produce a capacitive voltage divider, the sensitivity of the preamplifier is lower than would be first thought from examination of the circuit.

If a crystal cartridge other than a ceramic is to be used with this input circuit as shown, then it will be necessary to remove the existing capacitor and substitute another one to provide the correct input time constant (see last month's article on Transistor creamp Design Considerations).

Where a reader may desire to provide replay facilities for an existing stereo tape playback system, then an extra input plug must be located on the rear of the cabinet, and this wired to the input selection switch, which must be altered to remove the short between channels on the tape position, in addition to connecting the extra input to the second channel. This can be simply done during construction and a circuit for this mode will appear in the next issue.

We turn now to a short discussion of the Preamplifier circuit. Here again only one channel is shown although the interconnections to make a full stereo preamplifier unit are included where necessary.

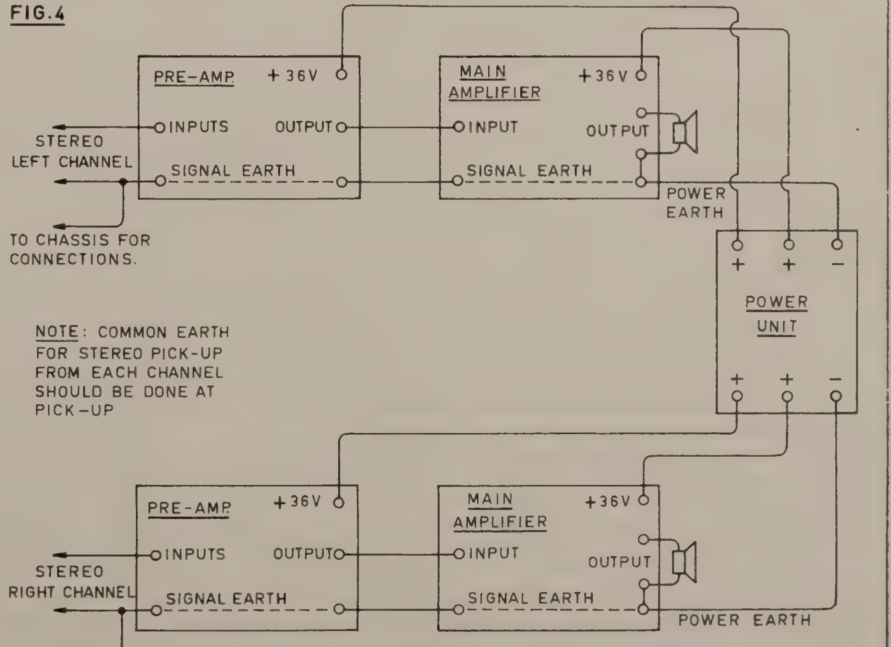
The first stage utilises two R.C.A. type 40233 low noise N.P.N. silicon transistors in a direct coupled compound pair commonly called the "Darlington" or "Super-Alpha" pair. This gives an input impedance of the order of ½ megohm. To keep this value of input impedance, any resistors used for biassing must be at least several times this value. Although silicon transistors have inherently low leakage currents and exhibit good thermal stability, it would not be wise to use resistances of such high values. Accordingly, the input resistor is made to look like a much higher value to the incoming signal by the use of a "boot-strap" capacitor coupling from the first emitter to the bottom of the base resistance, which is also the junction of the voltage divider which sets the base bias voltage. The two collectors are tied together, and the amplified signal appears across the 2.7k ohm load resistance. Coupling to the second amplfying stage, also using a 40233 is via the ganged volume control and associated "balance" control.

This control gives a range of + 6 dB — infinity, in other words, one channel can be cut off. The total amount in the positive direction varies slightly over the normal control range, but this is insignificant as a variation of listening level, as the balance control usually seems to be very close to the centre point if each side of the system is comparable.

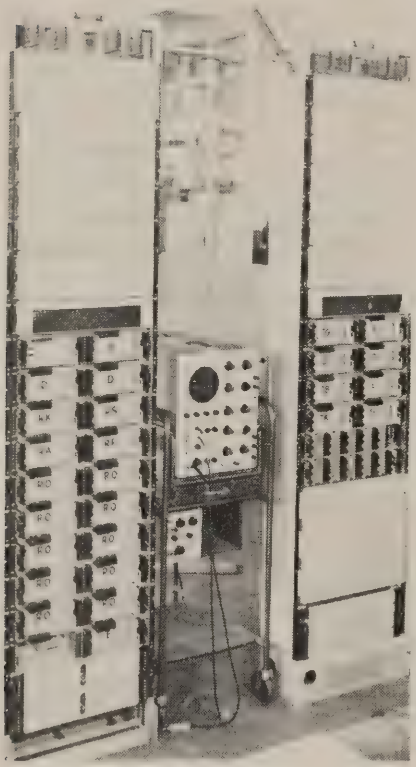
After further amplification in the second stage, the signal passes

Continued on page 26

FIG.4



BLOCK DIAGRAM SHOWING CONNECTIONS OF SEPARATE UNITS TO REDUCE EARTH LOOP TROUBLES



New Telemetry System For Electric Power Board

*By J. C. Buckingham, B.E.
Resident Engineer, Western Area
Waitemata Electric Power Board

The transmission and distribution of electricity from the New Zealand Electricity Department to the consumer is the function of Supply Authorities, such as the Waitemata Electric Power Board. Light current engineering plays an important part in this. In this article the telemetering side of the Board's activities will be discussed.

The word telemetering means "metering from afar" — the remote indication of a measurand over a communication link many miles long. Any quantity, whether analogue or digital in form, may be telemetered, with the most important one concerning the Waitemata Power Board, being System Load.

The Board buys power from the New Zealand Electricity Department, not at so much per kwh. or unit as the consumer does, but on a kilowatt maximum demand basis. These kilowatt peaks occur for only a very short time during the day and the shedding of any controllable load, such as storage waterheating, over these peak periods keeps the amount paid for power to a minimum. This is reflected in cheaper power charges for the consumer.

So that peak load times are known, the Board must be informed continuously of the actual loading on its system. This information must be accurate, immediate and reliable; any load reductions made must be easily discernable. The Board takes its power supply from four Electricity Department's substations, Henderson, Albany, Tahekeroa and Wellsford. To do this, a new telemetering system with a number of very real advantages was placed in service last year.

Types of Telemetering System

There are two classes of telemetering systems available; analogue and digital. In the analogue system, information is represented by a continuously varying analogue of the input signal or waveform, e.g. a direct current or voltage.

Digital systems imply transmitting a series of separately coded "words", each comprising one or more signal elements or digits. The shape, size or repetition frequency of the digit pulses means nothing — all the information being contained in the coding of the "word". This is known as pulse code modulation (p.c.m.).

The Board believes that a telemetering system employing p.c.m. is the only one which will give completely reliable and acceptable indications of the system load. Once the input analogue measurand is converted into pulse "words" at the supply substation, non-linearities in the equipment or in the communication channel cannot affect the result. By using digital readout for the load indication in the System Control room, digital-to-analogue conversion with its attendant errors is not required.

Although the above analogue types of telemetering systems can be operated over pilot lines, all suffer from two main disadvantages; noise on the communication channel and the inability to check the measurand from the receiving end. The point of supply farthest from Control is Wellsford, 50 miles away. The supervisory pilot lines connecting the two, run underneath 11kV distribution feeders and therefore suffer from induction effects and fault current surges.

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* From an address in May to the Auckland Branch, N.Z. Electronics Institute.

Quantities of noise are always present in the frequency band used for control and indication purposes. This noise must not in any way affect the telemetering readout. The ability of p.c.m. systems to work reliably over low-grade or noisy circuits is well-known, but it is only in recent years with the advent of the transistor and printed circuit techniques, that practical economic systems have become possible.

By using suitably coded "words" the scheme is made self checking. Hence any malfunction on the part of the equipment or communication channel is immediately detected at the receiving end and incorrect information prevented from being displayed.

General Description of the Board's Equipment

The scheme provides for the remote indication of one or two analogue quantities (megawatts and kilowatts) from each of the four points of supply. Transmission is in binary form over a voice frequency, frequency-modulated telegraph channel. Refer to Fig. 1 attached for a block diagram of the scheme.

transmitted to System Control over a voice frequency (V.F.) channel at 50 bauds. The V.F. equipment is of the frequency modulated type operating at a mid-band frequency as follows:—

Substation	**Mid-band Frequency**
Wellsford	1980 c/s.
Tahekeroa	2220 c/s.
Henderson	2220 c/s.
Albany	2460 c/s.

The frequency representing binary "0" is 30 c/s. above the mid-band frequency and when a binary "1" is transmitted the frequency is switched to 30 c/s. below the mid-band frequency.

At System Control, after passing through a V.F. receiver, the information is fed to the Receiver. Here it is placed in a temporary store while the code is checked, and recognition of the message start is carried out. If no transmission errors are detected the information is passed to a permanent electronic store where it is decoded and displayed on in-line digital indicators. These indicators will display the information directly, complete with decimal point. Thus no reading error will be possible.

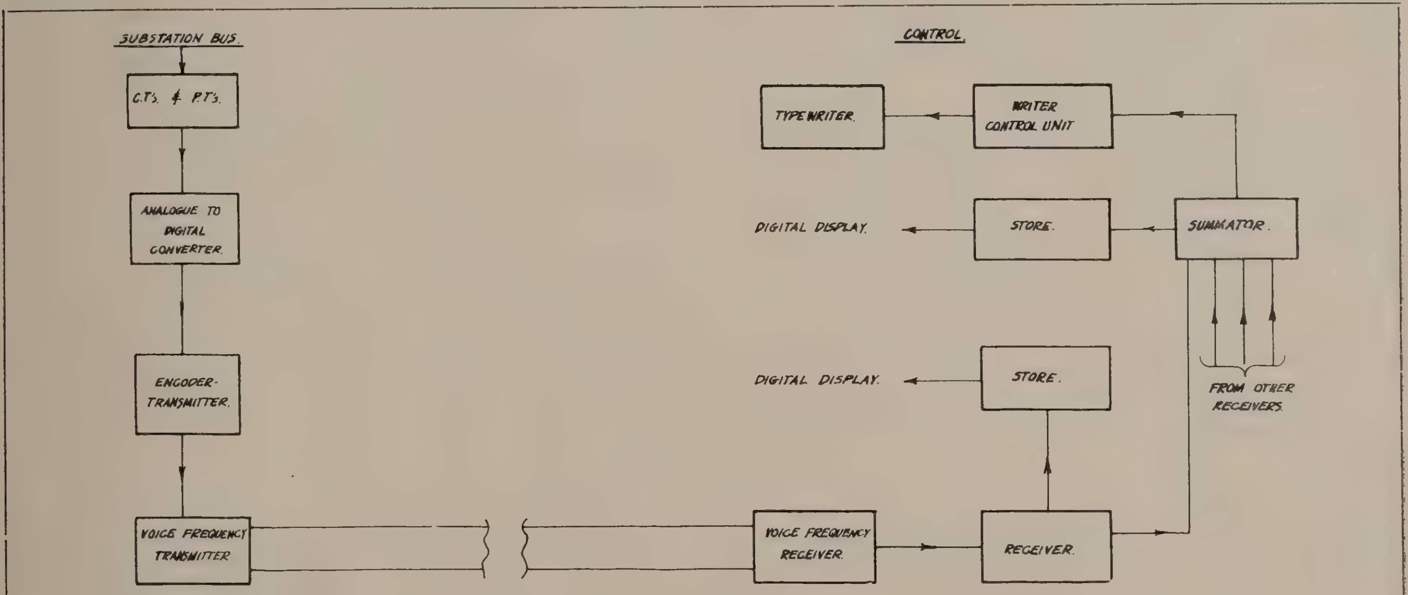


Figure 1: Main unit layout

The power at the substation bus is measured by precision current and potential transformers. Measurement at Tahekeroa and Wellsford is single phase and that at Albany and Henderson, three phase. The latter is performed by the two-wattmeter method. The transformer outputs pass to an analogue-to-digital converter, (A.D.C.), where a repetitive sampling technique is used to convert the analogue information into binary form. Once per second the A.D.C. produces a number of pulses which is proportional to the analogue quantity being measured. Each pulse represents 100 KW or 100 V depending on the measurand; hence a maximum of 100 pulses represents 100 MW or 100 kV. The pulses are transferred to the Encoder-Transmitter where they are counted by a binary-coded decimal counter generating a self checking code. This code is then

The megawatt information from each of the substations is also electronically summated and displayed, as a measurement of total power, on similar indicators.

A further facility provided at Control is the automatic printout of all power measurements on an I.B.M. electric typewriter. An electronic timer, giving an output every 5 minutes, is used to drive a 24 hour clock. The typewriter is operated once every 30 minutes or 5 minutes at the discretion of the operator, by controlling a single switch position. This switch also controls the type colour, red for 5 minute printouts, black for 30 minute printouts. A special sequencing device controls the writer to type first the time, in 24 hour clock time, followed by the four substation power measurements in order, Albany, Henderson, Tahekeroa and Wellsford and finally the summated power.

e.g. 17.30 57.3 48.5 04.2 05.6 115.6.

The overall accuracy of the system is ± 1% of full scale, from the input interposing transformers, to the digital readout. This accuracy applies also to the summation readout.

A separate measurement of each substation load is taken once each second and displayed. A summation is also displayed once each second.

If the code check unit indicates an error or the equipment malfunctions in any way, the audible alarm is brought on, the last correct indication is displayed and its background is made to glow red in colour.

Explanation of Technical Terms:

Before proceeding with a more detailed description, an explanation of some of the technical terms involved may be helpful.

Bit — A "bit" is a single pulse. It is the smallest unit of information used in pulse circuitry. Its presence or absence only constitutes the information, and thus it fits in with the binary system of numbering.

Word — A number of bits occurring together. A decimal digit may be represented, say, by a five bit "word".

Baud — A special type of bit used in telegraphic signalling. 50 bauds represents 50 impulses per second, each baud occupying the space of 20 ms.

Three decimal digit register — A register is a counter. A three decimal digit counter is one in which any number from 000 to 999 is counted, each digit separately, in some particular code.

i.e. 578 may be represented by

	Hundreds register	Tens register	Units register
	5	7	8
In pure binary form	0101	0111	1000

Shift register — A special type of counter in which pulses may be counted by sending them in one after the other, but the total count at any time may be extracted by the application of "shift pulses". These "count out" the total in coded form in much less time than taken for the "count in" and leave the register free for further counting.

Store — A type of counter which will hold a particular "count in" indefinitely. It may be quickly "emptied" and "refilled".

Ring Counter — A counter in which all the elements are joined in a ring, i.e. the output of the last element is connected to the input of the first element. At any time only one element is in a different state from the rest. Application of pulses is made to all elements simultaneously and the odd element is made to progress round the ring.

Gate — A circuit which opens or closes an electrical path upon the application of a control signal. Most extensively used in the telemetering scheme.

Toggle — A device having two stable states, one "on" and the other "off". The application of a pulse will turn the device on and it will remain in this position until a second pulse is applied. This will turn it off.

Detailed Description:

Interposing Transformers—

At Henderson and Albany a three phase supply is used for metering purposes. Thus two line currents and two phase - to - phase voltages are required. At Tahekeroa and Wellsford only a single phase supply of line current and phase to neutral voltage are used.

Four off 5 + 5/5 amp. summating C.T's. are used at Henderson and Albany.

A 5 amp. output from the C.T's. indicates 100 and 10 MW respectively. When this maximum value is exceeded at any particular substation, e.g. Albany exceeds 100 MW., simply altering the C.T. ratios to a X10 multiple and the altering of the decimal point connection in the in-line indicators, will give full scale outputs of 600 and 60 or 1000 and 100 MW respectively, still correct to ± 1%. Since the whole scheme has been kept decimal in notation this procedure may be repeated many times, the decimal point of the in-line indicators being moved one position to the right each time.

The Analogue-to-Digital Converter—

The interposing transformer outputs are passed to the analogue - to - digital converter, A.D.C. Reference should be made to Fig. 2.

The linear sawtooth generator and the voltage comparator generate a pulse whose length is proportional to the d.c. voltage V1. A start pulse is applied and the sweep is triggered off, starting above earth potential. As it passes through earth potential the voltage comparator gives out a pulse to trigger on the toggle. The sweep continues until it reaches the potential V1 when it gives out another pulse to trigger off the toggle. The sweep is started above earth potential and the toggle triggered on as it passes through earth to eliminate any error due to the variation in the start of the sweep potential.

As the toggle turns on and off, it is used to open and close the "and" gate. Also applied to this gate is the output from a variable frequency oscillator.

The frequency of the pulses from this oscillator is directly proportional to the voltage V2. Thus the number of pulses in the counter at the end of a cycle will be those from the variable frequency oscillator allowed through the "and" gate while the toggle is on; i.e. proportional to the product of V1 and V2.

The voltage V2 is made directly proportional to the a.c. voltage from the interposing potential

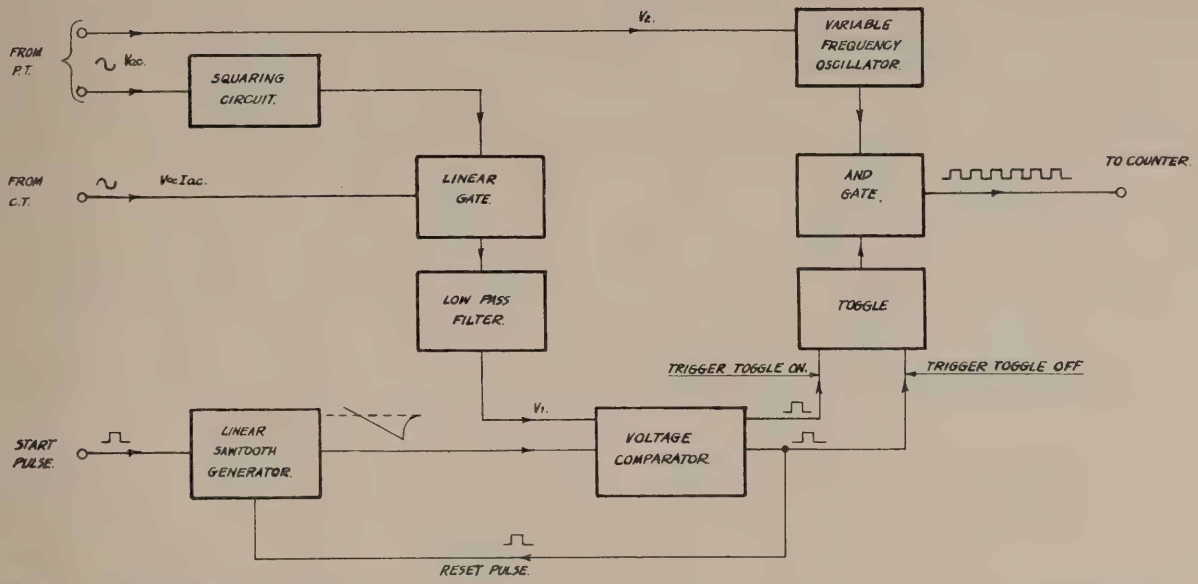


Figure 2: Analogue-to-digital converter

transformer. If voltage V1 is made proportional to I cos φ where I is the output from the interposing current transformer, the count will be proportional to V. I cos φ or watts.

If a single parameter were to be coded, the frequency of the pulses would be fixed by keeping V2 constant and the gate would be operated by the analogue input V1.

A voltage proportional to I cos φ is obtained as follows: The a.c. voltage waveform from the potential transformer is squared and used to control a linear gate. A voltage proportional to the current waveform at the output terminals of the current transformer, is passed through the gate. The gate is made very linear. The gated waveform is applied to a low pass filter and the mean value obtained. This mean value is proportional to I cos φ.

The Message—

The pulses derived in the A.D.C. are passed to the Encoder-Transmitter. The main function of this unit is to count the number of pulses from the A.D.C., to encode the resulting total into a binary-coded decimal form, and to transmit the information to Control at 50 bauds with a repetition timing of 1 second. A self-checking code is used that will detect all single errors and a proportion of all others. The maximum number of pulses supplied by the A.D.C. in any one sampling time is one thousand. A three decimal digit register is therefore used, counting from 000 to 999. Each decimal digit is represented in a five bit binary form and the following representations are used:—

Decimal	Code
0	01000
1	10100
2	11010
3	11101
4	01110
5	10111
6	01011
7	00101
8	00010
9	10001

Each three figure decimal number is therefore represented as a 15 digit binary code.

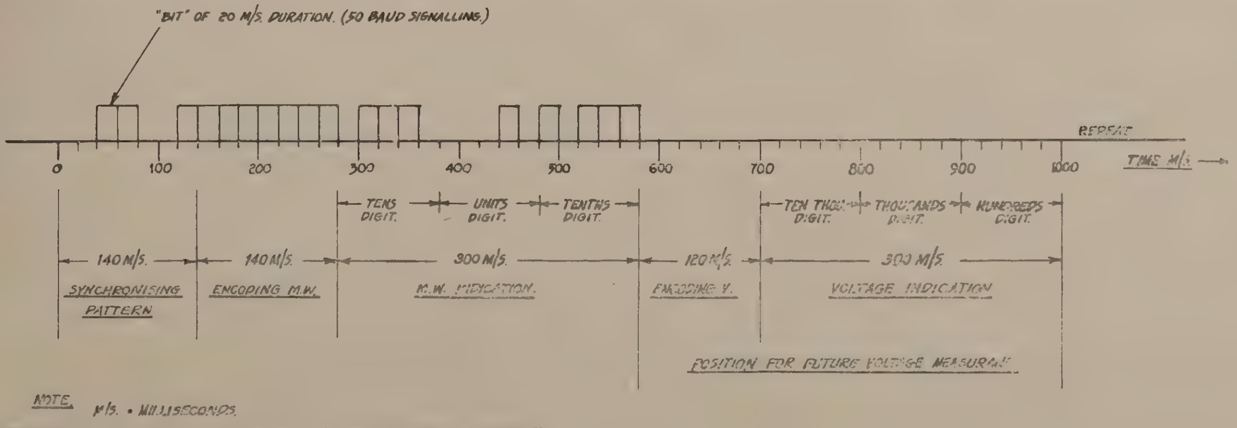


Figure 3: Typical message layout: Albany reading 48.5M.W.

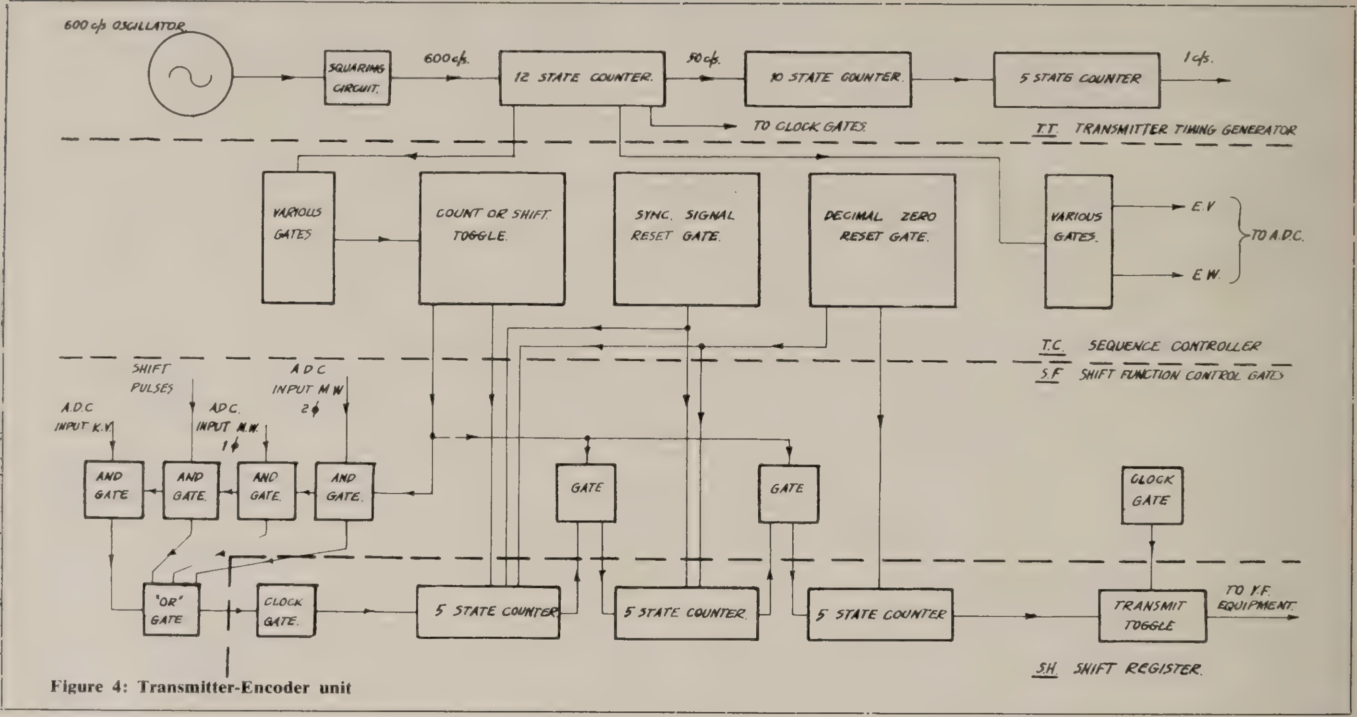


Figure 4: Transmitter-Encoder unit

By studying the above codes it will be seen that each differs from every other binary code used by at least two digits. It is this feature that supplies the error detecting properties of the code, since, if a single error occurs the resulting code is not recognisable as another binary code associated with a decimal digit. A single error is by far the most common form of error. When used in a 15 digit binary number this method will detect 96.94% of all possible error combinations including all single errors. It should also be noted that the combinations of all "ones" or all "noughts" are not used, hence line and equipment failure can also be detected.

The message being transmitted at 50 bauds contains 50 bits in each one second time cycle. Because it is continuously repetitive it is necessary to "mark" some point during the cycle to denote the beginning (or end) of the message. For this reason a seven bit synchronising pattern is inserted in the message. This consists of the code 0011001 which is unique, i.e. provided there are no transmission faults, it will not occur again within the message structure.

The synchronising pattern is followed by a seven bit space of all "ones" during which time the A.D.C. and transmitter encode the power measurand (MW). After this space, fifteen bits of coded information, representing the power reading, are transmitted. This is again followed by a further space of six bits. This space, consisting of all "ones" or all "noughts" is utilised to encode the voltage measurand. Until the voltage facility is incorporated, six "noughts" will be transmitted. The final fifteen bits of the message contain the information representing the kV measurand. A typical message layout is given in Fig. 3.

The Transmitter-Encoder—

The transmitter-encoder consists of four parts:—

1. Timing Generator, TT.
2. Shift Register, SH.
3. Sequence Controller, TC.
4. Shift Function Control Gates, SF.

See Fig. 4.

SH consists of three, five bit, shift registers which can be connected alternatively as one shift register or as a binary coded, three decimal digit counter. This change is controlled by a "count or shift" control which decides the function being performed.

The timing generator consists of a 600 c/s. oscillator followed by a divide by twelve counter. The output of this counter thus has a pulse repetition frequency, p.r.f., of 600/12 = 50 c/s and the pulses are known as clock pulses. Two outputs are taken, one 10 ms. after the other. One of these sets of clock pulses is used to drive a further counter with 50 states, thus producing a cycle time of 1 second. The start of each 20 ms. period is marked by one of the clock pulses, the other providing a mark half way through each bit period.

A cycle is started by the timer TT setting the "count or shift" control to "count". A signal is then sent from the timer to the ring counter SH which sets up the code for decimal zero, i.e. 01000 in each of the three decade counters. A further pulse from the timer starts the A.D.C. sampling period which lasts no longer than 100 ms. during which time the ring counter encodes the digital output from the A.D.C. The timer then sets the "count or shift" control to "shift" and clock pulses are directed into the now shift register SH, shifting the encoded information to the V.F. equipment and hence to line. The cycle is repeated for the voltage measurand, but finally after eleven bits of this have been transmitted a signal from the timer sets the seven bit synchronising signal into the shift register, behind the information being transmitted and this is transmitted in turn.

The Receiver—

The Receiver consists of the following units:—

1. Timing Generator, TT.
2. Shift Register, SH.
3. Error Detection Unit, CO.
4. Synchronising control and Alarm, SY.
5. Output Stores, SO (a, b and c).

See Fig. 5, TT and SH are the same as those used in the transmitter.

Information from the pilot line is passed through the V.F. equipment to the receiver. In order to receive this information correctly, clock pulses have to be generated in the receiver in synchronism with those in the transmitter. The timer unit used is the same as that in the transmitter with the exception that the oscillator is slightly higher than 600 c/s. but can be switched to slightly lower than 600 c/s. This is done by an oscillator controller unit in SY which detects from the transitions in the incoming information whether the receiver is running fast or slow in relation to the transmitter. This unit switches the receiver oscillator to either 597 c/s. or 603 c/s. in such a way that over a period of time its frequency averages exactly that of the fixed transmitter oscillator. TT also generates two sets of clock pulses with a p.r.f. of 50 c/s, one 10 ms. out of phase with the other, as explained above for the transmitter. One of these clock pulses is used to continuously shift the information from the V.F. receiver to the 15 bit shift register SH.

When the seven bit synchronising pattern is con-

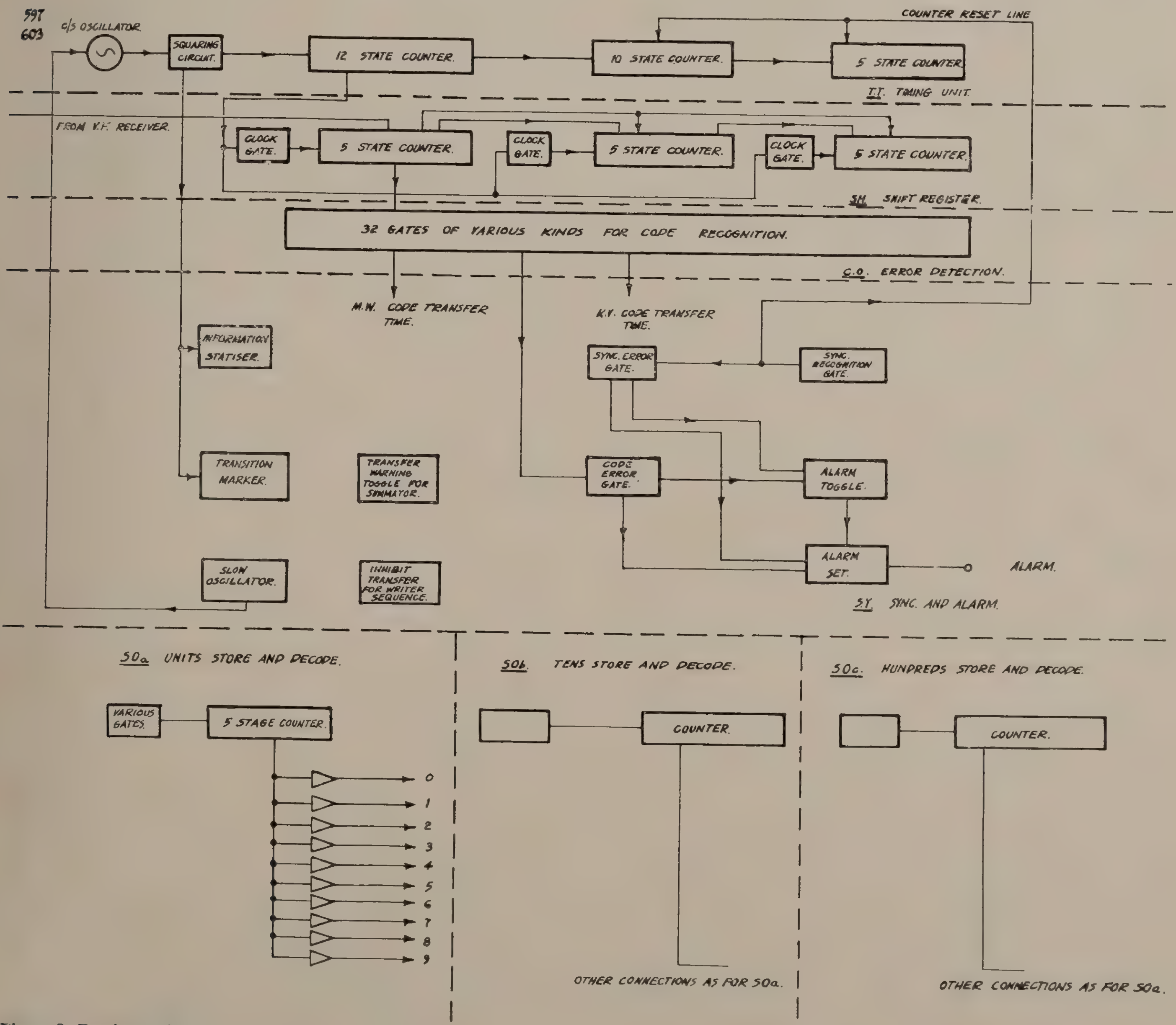


Figure 7: Receiver unit

tained in the right position within the shift register, a sync. recognition gate in unit SY resets to zero the divide by 50 timer in the timer TT. Every bit time within the message may then be determined from this point.

All the incoming information passes through the first five toggles of the shift register SH, the outputs of which are connected to a set of code recognition gates in CO, one set for each possible code. If the code is correct, the information is transferred to the permanent output stores SO a, b and c, where it is decoded for the digital display. If, however, the code check does not recognise the received code pattern an alarm is given which prevents the transfer of all information after that time within the one second time cycle. The alarm is not reset until after a full message is received correctly. While the alarm is present the digital display will show the last correct indication but the background will glow red in colour.

A "freeze control" facility is also provided which prevents the transfer of new information from the receiving shift register SH to the output stores SO during the times when the summator or typewriter are acting on the information already stored.

The Summator—

The MW information displayed by the four receivers is regularly added together and displayed by the summator. The total time for a complete addition is less than 100 ms. and is repeated each second.

The summator consists of the following units:—

1. Clock Pulse Generator, S.P.
2. Summator Selector, SS.
3. Control & Carry Unit, S.U.
4. Totalising Output Store, S.O.

Because each addition takes a finite time, each receiver contains an indicator which prevents the addition of that receiver when the information in it is about to change. Also because the four receivers are asynchronous the summator contains a selector unit in SS to decide from which receiver the information is to be taken and added to the total. This selector examines each receiver in turn to decide if the information it contains has already been added to the current total, and if it is about to be changed as determined by the indicator.

The summation cycle is initiated by the Albany receiver transferring new information to its output store. This sets up the indicator on receiver 1 and resets the summation counter to decimal "0", thus destroying the old total. The clock pulse generator SP next drives the receiver selector unit in SS which decides from where the first set of information is to be taken. When this is done ten clock pulses are fed from the generator to each output decade store of the chosen receiver, thus causing them to count backwards 10 steps. Each decade store therefore contains its original count unchanged. These pulses are also fed to the summation counter decades in SO but are stopped when the corresponding receiver decade goes through zero. The summation counter then contains the same information as the first chosen receiver.

The receiver selector then chooses the next receiver and the process is repeated. Carry digits in SU are added to the next higher decade after the addition of any particular receiver has been completed.

When all the receivers have had their information added to the summation counter, this stores the total until the next cycle is initiated. The total is then decoded and displayed. Since the time taken for summation is less than 100 ms. this will be seen as a single "flash off", which signifies that a new total has been obtained even if the actual reading does not change.

The Writer Sequence Controller and Clock—

This section of the equipment controls an I.B.M. electric output writer to provide a permanent record of all the power measurements including the summation. The writer operates every 5 minutes or 30 minutes as decided by a single key. If a record is required every 5 minutes it is typed in red, 30 minute operation producing black type.

An electronic timer working from the 50 c/s. mains frequency produces a pulse every 5 minutes. These pulses are counted by a circuit which provides a binary readout of time, on a 24 hour basis, coded in a similar code to that used for the MW. information.

Every 5 or 30 minutes, as determined by the key, a writing sequence is initiated. However to avoid information changing whilst the writer is in operation the writing sequence is not started until just after a complete summation has taken place. During this summation, after the information from each receiver has been added to the total, a "freeze" signal prevents each receiver from changing its stored information until after the complete writing sequence has taken place. When all receivers have been "frozen" the writer selector connects decoding relays to each receiver output store in turn and drives the writer to record the information.

All the written information for one writing sequence is contained on one line of type. This comprises the time followed by information from Albany, Henderson, Tahekeroa, Wellsford and finally summation. Each individual MW reading is separated by a space determined by the typewriter tabulate stops. The writing cycle takes approximately 3 seconds depending upon the tabulation spacing, and no new information can be received during this time. Extra space is available on each line for other information, e.g. transformer tap positions, and at each midnight the operator can type in the day, date and weather conditions.

Conclusion

The Waitemata Power Board's telemetering scheme desribed here is one of the most modern in the world. It was the first p.c.m. system for electrical load measurement to be developed in U.K. The original specification for the design was produced by the Board's engineering staff.

Continued on page 27

Looking at . . .

Accuracy of Electronic Digital Counters

In view of the increasing number of digital counters of varying accuracy which are appearing in laboratories and industrial concerns throughout the country, we felt that some notes, extracted from information to hand, would be of value.

In general, there will always be a possible error of ± 1 count on the last significant digit. This error, together with the discrimination required, will determine whether a Frequency or a Period measurement should be used. The effects of this 1 count error will be least on the highest counts, judged on a percentage basis.

The attainable accuracy of a particular counter is shown in the graph. This is a plot of percentage accuracy of maximum 1 part in 10^7, versus frequency and clearly shows the cross-over point below which determination of frequency is better performed by period measurement.

The ± 1 count ambiguity is inherent in measurements made by an electronic counter because the gating is normally not synchronised with the input signal. The gate may open or close while an input pulse is passing through, so this pulse may or may not be included in the final count.

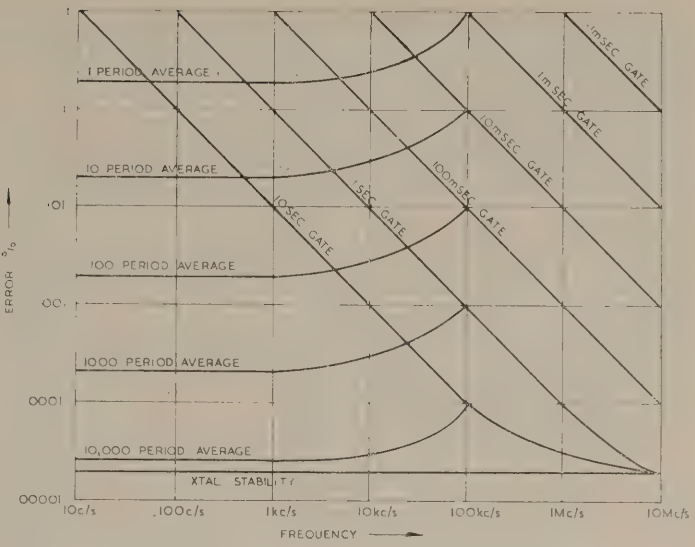
FREQUENCY MEASUREMENTS

In frequency measurement, accuracy of the count is mainly determined by the accuracy of the internal standard which provides the timing gate, and thus the counting interval. In addition, there is the ± 1 count error mentioned previously and therefore for a given counting time or gate period, the highest frequencies will be displayed most accurately, with the greatest discrimination.

Let us see how the accuracy of the timing standard will affect the count displayed.

If our internal standard is high in frequency by 10 cycles at 10 megacycles i.e. 1 part in 10^6 high (a quite usual amount of error, then a standard external signal accurately controlled to 1 megacycle will give a count of 1 million ± 1 ± the 1 digit error; that is a maximum error of 2 cycles high or low. If, however, we count a 10 megacycle standard frequency with the same counter, the error will be ± 10 cycles ± 1 digit, i.e. a maximum of 11 cycles.

It should be noted here that use of the internal oscillator source for checking purposes will not show up such an error, as the oscillator frequency and the gating time are both directly related. Thus, even if the crystal standard has drifted, say, 10 cycles high, it will still show a correct count.



PERIOD MEASUREMENTS

The period measurements method is also affected by the time base stability (see later) and the ± 1 count error. Accuracy is also affected by an ambiguity in triggering level of the gating circuits. For sine wave inputs the total possible error may be expressed as $\frac{1}{\pi} \times \frac{EN}{ES}$ where

EN = total noise including that due to counter circuits.

ES = signal level.

If we use the average of a number N of period measurements then the error is reduced N times. The actual percentage accuracy is equal to

$$100\left(\pm\frac{FIN}{NFS} \pm \frac{e}{N} \pm E\right)$$

where FIN = Input Frequency in cycles per second.
FS = Standard Frequency in Cycles per sec.
N = number of periods averaged.
e = Trigger error.
E = Time base accuracy expressed in decimals.

INTERNAL STANDARD ACCURACY

If we are using a standard in our counter with a stated short term stability of say 1 part in 10^8 it must be kept in mind that short term stability usually indicates the total variation from zero reference over a short period.

With a good quality standard this variation should be very small. For accurate counter work it is not the short term stability which is primarily important, but rather the long term stability which matters.

The time base accuracy is basically determined by drift rate of the individual time base; the absolute value of frequency offset at standardisation, and the time lapse since standardisation.

Let us suppose that our counter has a quoted stability of 1 part in 10^7 per week. This first assumes that the short term stability is probably 1 part in 10^8 (a good quality instrument). Now also assume the counter is well run in. It is now set as accurately as possible against a more accurate standard source.

After the first week, error is likely to approach ± 2 cycles at 10 megacycles. After 2 months, error is likely to be ± 20 cycles at 10 megacycles or ± 2 cycles at 1 megacycle. In other words accuracy of

Continued on page 27

ENQUIRY CARD AD. 13

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>
> **Operating** (without batteries) —15°C to +55°C, to 15,000 ft.
>
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>
> **Operating** (with batteries) —15°C to +40°C, to 15,000 ft.
>
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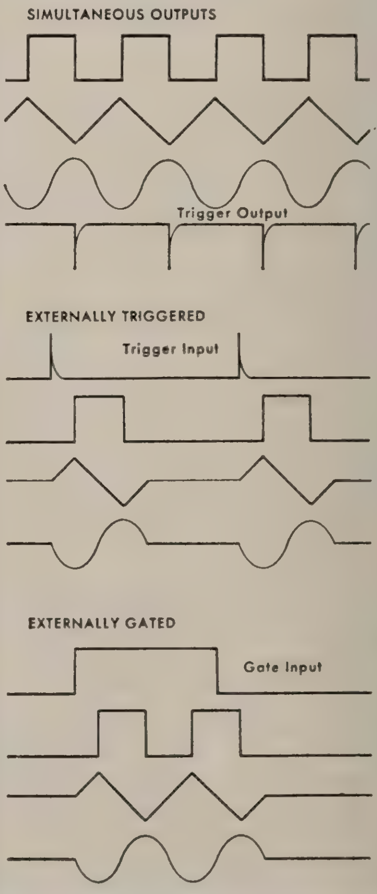

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SERVICEMAN'S COLUMN

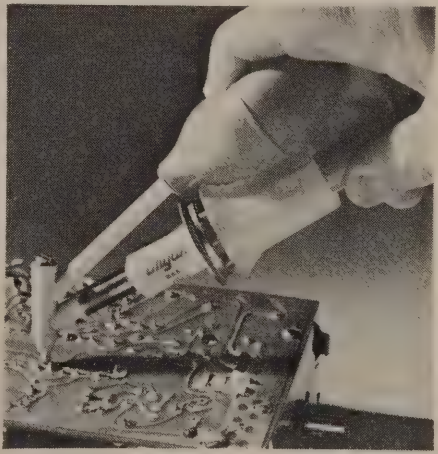
Conducted by J. Whitley Stokes

Servicemen in this country have now had seven years to become accustomed to printed circuit wiring. Well, perhaps not quite as long as that but nevertheless the first models using "P.C." appeared on the market towards the end of 1958. How time flies — it seems as if the technique is still quite new but there are the figures. Honours for first place, are, I believe, equally divided between the Philips Printina and the Philco T6 Transitone.

From the servicing angle it has meant learning new techniques, not so much from the diagnostic point of view but rather from the angle of removing and replacing defective components. This remark applies equally whether the particular piece of equipment using a P.C. board is transistor portable, power operated home radio or TV Receiver.

With hind sight it is possible now to say that there has been much unnecessary grief caused not by the use of the P.C. board as such, but because of it being inadequately supported and mounted. An early cause of much trouble in some models was the mounting of large sized gang condensers and volume controls directly on the P.C. board. This lead to breakage in the wiring, or even of the board itself, at the points of attachment. Probably the most horrible example of poor design was to be found in one AC/DC model which used a PC board supported about half an inch above the cabinet bottom by just two screws near the middle. The ballast resistor was mounted vertically on the board without any intervening brackets and as both ends of the board were unsupported for about four inches it didn't need much imagination to envisage the results. Due to the use of a quite small cabinet the temperature rise soon caused the board to buckle until one or both ends touched the bottom of the cabinet. I have actually seen a hole melted right through the bottom of the plastic cabinet at the point opposite the end of ballast resistor mounting bolt. This is not to mention a charred cardboard back but of course this could have happened whether or not a P.C. board had been used. Lest I be accused of being wise after the event, I might say that at the time when the manufacturer first sent me three of these then "latest models", I returned them after one look inside the cabinet. They were withdrawn after about a year.

For better or worse the PC board is here to stay so servicemen will have to learn not merely to live with it but to live "off" it to use a colloquialism.



Any serviceman who has had occasion to remove a multi-terminal component, for example an IF transformer, from a P.C. board has realised the difficulties involved in trying to heat all the terminals simultaneously in order that it may be freed from the embrace of the soldered points. In America this led to the development of specially shaped interchangeable bits for soldering irons, shaped somewhat like miniature branding irons, which could be held in contact with all the protruding lugs of the component thus melting the solder. This was a step in the right direction but had two drawbacks, one being that it was necessary to have a separate specially shaped bit for every size and make of component and even then it still left the mounting holes in the board covered with solder after removing the component.

The next step was the development of a special "de-soldering" tool. This takes the form of a conventional soldering iron but instead of having a bit the business end is provided with a small hollow tube which, when heated by the element, can be slipped over the end of the wire or lug protruding through to the soldered side of the board. In addition to melting the solder however the tool is provided with a device for sucking up the molten solder thus leaving the hole in the board clear. Each lug of a multi-terminal component has to be treated separately but the result is the easy and clean removal of the defective component. After having used one of these de-soldering tools I regard them as being quite indispensable. Unfortunately the current import restrictions on all types of soldering irons seem to be affecting their availability on the local market, so if you don't possess one I should try very hard to do so if I were you.

. . . . .

Apparently it just hasn't yet occurred to any importer of record changers or players, of the ordinary commercial type, to request the manufacturer not to supply cartridges fitted with 78 stylii. Ten years after the manufacture of 78 rpm records has ceased, purchasers of record players and radiograms are being forced to accept a 78 stylus which in the vast majority of cases is not required and never used. Where the particular cartridge uses separate stylii for LP and 78 there is no problem, it is just a matter of fitting an LP (.001" radius tip) and a pure stereo (.0005" radius tip) stylii and marking the turn-over knob "stereo" and "L.P." In the case

Continued on page 31

STEREO AMPLIFIER

Continued from page 15

through the two tone controls. These are the current "dual" of the conventional high impedance passive control. The variation of response about the centre point with respect to 0 dB at 1000 c/s is taken at 100 cycles + 12 dB — 12 dB and at 10 kc. + 8 dB — 15 dB.

It seems that all low impedance continuously variable tone controls using potentiometers with a linear resistance versus rotation law, suffer from the problem that most of the boost or cut seems to occur in the latter part of the rotation of the potentiometer — this preamplifier is no exception. However, the onset of cut or boost is not too rapid, and there is a little lee-way around the centre point because of this.

The bass section of the tone control is included as part of a negative feedback loop around the second stage, which ensures low overall distortion in the preamplifier section.

The Power Supply

As far as an A.C. power supply is concerned, nothing could be simpler than the one employed in this amplifier system. One common power transformer and rectifier system serves both channels. The power transformer is a special type No. S149 manufactured by Transformer Winders Ltd. of Auckland. This provides 27 volts A.C. per side which is rectified by two 100 volt (P.I.V.) 2 amp silicon diodes R.C.A. Type 40266 operating in a full wave capacitor input circuit. These diodes feed via a 1 ohm surge limiting resistor made in a similar fashion to those used in the emitters of the output transistors, into a reservoir-filter capacity of at least 1000 mfd at 40 volts working. It is from this point that both driver and output stages of each channel are supplied. To provide extra filtering and decoupling in the low level stages, separate decoupling resistors to each preamplifier chain are used from the common supply coupled with electrolytic capacities of 250 mfd or more.

The no-signal D.C. voltage across the main D.C. line is in the vicinity of 36 volts — dropping to under full signal conditions.

To ensure low hum level, and to avoid any interaction between channels, it is necessary to ensure that all power earthing is returned to one point — the junction of the transformer centre tap and the negative leads from the filter capacities.

The accompanying block diagram shows the power and signal earthing requirements for coupling input to pre-amp to main amplifier and amplifier to speaker.

In a concluding article, we will show and describe some of the constructional details, together with measurements of performance characteristics and in addition, we will also publish a circuit of the low level, low impedance input preamp suitable for use with magnetic pickup.

ENQUIRY CARD AD. 14

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TELEGRAMS "RADTRAD" AUCKLAND

NEW TELEMETRY SYSTEM

Continued from page 22

The scheme has an overall accuracy greater than most other schemes. Direct digital readout means no reading errors, as there would be when reading the conventional indicating instrument. The speed of response, one new indication per second, is fast enough to allow rapid speed control.

Extending the equipment to enable it to read to greater magnitudes is extremely easy. As the input C.T. ratio is changed, the resistive burden across the interposing C.T's is altered and the decimal point in the digital display shifted one position to the right. Full scales of 100 to 1000 MW for each substation are thus obtained, still accurate to ±1%. Provision has been made for the future telemetering of volts.

One of the more important points is that this is possibly the first scheme to incorporate no moving parts between the substation bus and the digital display. This, together with the use of transistors, printed circuits and wire wrapped connecting joints instead of soldered ones, makes for ultra reliability and very low maintenance.

The cost of the complete equipment was £11,124. If, by its use, the peak load can be kept only 1 MW. lower than by other methods, then the scheme will pay for itself in under 2 years.

Laboratory Report on . . .

Pacemaker MA3 Amplifier

—Unit from H. W. Clarke Ltd.

This amplifier is a small valve type suitable for general purpose use where large powers are not needed. The unit comprises a single ECL 86 valve plus semiconductor rectifiers in a metal cabinet 11½'' wide by 5'' deep by 4'' high. The ECL86 is rated at 4 watts in single ended class A service but at this figure the distortion on our sample was a little high and a good output is obtained at 2.5 watt level with really excellent output at a lower level of 1 watt and outputs at intermediate levels sound very pleasing. Purists will have it that any amplifier with distortion over 2% is not suitable for music — this we do not believe and live tests with the MA 3 prove this. Loud peaks on both classical and popular records come through well when the average level is comfortable for a small living room.

Technically the circuit has no tricks and the layout is simple, most components being wired onto a printed circuit board. We do not envisage service troubles but components are easily replaceable. The only comment we would make on the design is that the filter electrolytic capacitors should be more firmly mounted as excessive vibration may eventually fracture the long tails down to the printed circuit board. (Such vibration could result if the unit was carried about in a car).

Technical

(a) Power versus Distortion

Frequency	Power 1W	1.5W	2W	2.5W
100c/s	4.6%	6%	10	16
500c/s	2.1	3.6	5	8.5
1Kc/s	2.5	3.3	5	5
5Kc/s	2.5	4.4	7	20
8Kc/s	3.8	6.2		
10Kc/s	4.6	14		

(b) Frequency response for 1 watt output relative to 1Kc/s with tone controls in central position

40c/s	—1dB
100c/s	+3dB
500c/s	+2.5dB
1Kc/s	0dB
5Kc/s	—11dB
8Kc/s	—15dB
10Kc/s	—16dB

(c) Tone controls: relative to central position

Bass

100c/s	—2dB	+1dB
500c/s		nil

Treble

500c/s		nil
1Kc/s	—0dB	+2dB
5Kc/s	—0	+13
8Kc/s	—0	+16
10Kc/s	—1	+17.5
12Kc/s	—1	+17
15Kc/s	—2	+19
20Kc/s	—3	+20

Hum

—45dB down (open circuit input all controls max)

Output Impedances 3 ohm and 15 ohm

Sensitivity 190 mV in for 1 watt
280 mV in for 2 watts

Comment

It will be noted that central position of the treble control does not give a level response and that almost full treble ''boost'' is required to compensate for the falling frequency response. The treble control is then, rather a ''cut'' control than a boost one. The deficiency in an effective bass control is, in many ways, made up for by the good low frequency response; 40c/s output being only 4dB down from that of 100c/s.

For the price asked the performance is good and this amplifier will suit many looking for a small amplifier suitable for entertainment purposes. For low level output pick-ups a preamplifier would be necessary but the sensitivity is adequate for most input sources. The good low frequency response would be useful when used as a guitar amplifier.

Looking at FREQUENCY COUNTER ACCURACY

Continued from page 23

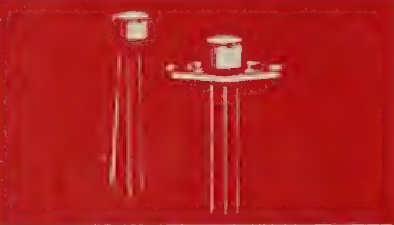
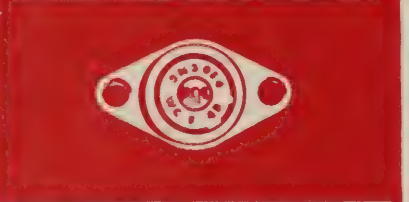
the counter has been reduced by a factor of 10 in just over two months.

Normally, it can be taken that the short term stability error would oscillate around the mean frequency. Long term stability or drift, however, is generally in one particular direction and this is usually higher in frequency.

Over a period of years, the monthly drift error will gradually become less, and the better the quality of the crystal, the less time is required for this improvement to be noticeable. The drift, however, never drops to zero.

Graph by courtesy of Marconi Instrumentation.

ENQUIRY CARD AD. 16

RCA's Broad Economy Silicon Line Offers Blocking Voltages to 450 V Currents to 30 Amperes	12-Volt Supply/Inverter Power to 350 W/Audio Power to 100W/ Regulators Short-Circuit-Proof to 150W	Medium-Voltage/Inverter Power to 800 W/Audio Power to 300W/ Regulators Short-Circuit-Proof to 150W	High Voltage High Transients Inverter Power to IKW Audio Power to 300W Regulators Short-Circuit-Proof to 150W
 TO-5 AND FLANGED TO-5 I_c MAX to I AMP . P_t MAX = 5 and 10 W	**RCA 2N3053** V_{CEV} max 60V h_{FE} @ I_c = 150 ma 50-250 f_T 100 Mc (min)		**RCA 2N3440** V_{CEO} (sus) min 250V h_{FE} @ I_c = 20 ma 40-160 f_T 20 Mc (min) **RCA 40256** (TO-5 w/flange) θ_{i-c} = 15° C/W
 TO-66 PKG. I_c MAX to 4 AMP . P_t MAX = 29 W	**RCA 40250** V_{CEV} max 50V h_{FE} @ I_c = 1.5A 25-100 f_T (typ) I Mc	**RCA 2N3054** V_{CEV} max 90V h_{FE} @ I_c = 0.5A 25-100 f_T (typ) I Mc	**RCA 2N3441** V_{CEV} max 160V h_{FE} @ I_c = 0.5 Adc 20-80 f_T (typ) 0.8 Mc
 TO-3 PKG. I_c MAX to 15 AMP . P_t MAX = 117 W	**RCA 40251** V_{CEV} 50V h_{FE} @ I_c = 8A 15-60 f_T (typ) 0.5 Mc	**RCA 2N3055** V_{CEV} 100V h_{FE} @ I_c = 4A 20-70 f_T (typ) 0.5 Mc	**RCA 2N3442** V_{CEV} 160V h_{FE} @ I_c = 3Adc 20-70 f_T (typ) 0.6 Mc
 TO-3 PKG. I_c MAX to 30 AMP . P_t MAX = 150W	**RCA TA-2650** V_{CEO} 40V h_{FE} @ I_c = 15A 15-60 f_T (typ) 700 Kc	**RCA TA-2544** V_{CEO} 60V h_{FE} @ I_c = 10A 15-60 f_T (typ) 700 Kc	**RCA TA-2645A** V_{CEO} 140V h_{FE} @ I_c = 8A 15-60 f_T (typ) 500 Kc

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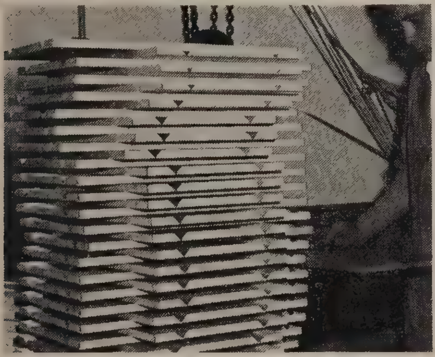
CAMERA — VIEW —

Inductance Specialists Ltd.
1277 Cameron Rd., Greerton, Tauranga
Manager: E. J. Palmer, A.M.I.E.R.E.

After many years in Wellington, a move to Tauranga may seem to be away from the centre of things, but for Inductance Specialists Ltd. it has been a change that has brought rapid expansion of production in all departments. In fact these departments — five of them — are the key to the success of the company. Their "Q" symbol is well known for R.F. coils and coil kits etc. This was the first-established side of Mr. Palmer's company and is still the most important and largest section. Several other facets of his operations show how a variety of associated products can develop from a single line and thus strengthen the general security of the company.



Chassis in the course of construction before bending.

The improvement in sensitivity of car radios, especially, and the advent of television, brought an increase in the need for interference suppresion. Inductance Specialists was the first company to introduce a full line of suppression filters on a production basis. Such manufacture benefited from the background of experience and production facilities that an R.F. coil manufacturer could be expected to possess. This was the case, and today the leading domestic appliance manufacturers go to "Q" for interference suppression components rather than design and wind their own. It will be appreciated that the maximum level of interference from interference generating devices is now legally specified and the onus is on the manufacturer to ensure that his appliances conform to the terms of the appropriate British or New Zealand standard specifications.

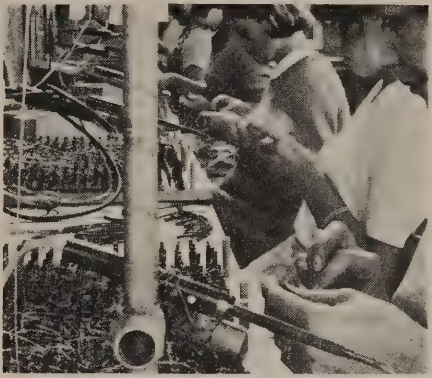
Today, as a result "Q" coils and R.F. transformers can be found in many television sets in this country. At the time of our visit, the coil department, shown in the illustration, was in the midst of a run of over 36,000 for a television setmaker. This production line, although allied to R.F. coils, is flexible enough to provide a variety of types, while the production staff similarly are versatile.

In addition to the above, 7 and 10m/m square transistor coils were also being manufactured in large quantities. This is also a comparatively recent addition to the "Q" range and already many thousands are supplied each month to radio receiver manufacturers.

Additional planning for the future is reflected in the purchase of a multiple head automatic relay winding machine which will be in operation before the end of this year. This will enable Inductance Specialists to quote competitively against both New Zealand and overseas manufacturers in this field.

Soldering leads on 10m.m. former — note long finger nails for locating fine wires. Photo through magnifying glass.

"Q" broadcast and shortwave kits have been familiar now for many years and the mechanical plant needed for chassis-making has grown rapidly with the result that the sheet metal department — chassis and cabinet work — is expanding quickly. This section appears to hold considerable promise, and, not being required so much for quantity production, is able to make chassis or cabinets on a "one-off" basis to customers' requirements.



General production view.

Although Inductance Specialists moved their factory to Tauranga to tap the labour market (and after all, a trained staff including forty young women is not so easy to find), there is no denying that the major market is at their back door, over the Kaimai Ranges — Auckland Province with almost half the nation's population and industry.

The progress made by Inductance Specialists is an example of diversification stemming from specialisation—from R.F. Coils into suppression filters, miniature transistor coils and relays, and from R.F. kits into chassis, cabinets and sheet metal work. That it has paid off is obvious, for already space is at a premium. From the outset, Mr. Palmer, designed the present factory (providing almost 5 times as much floor space as the Wellington premises), to accommodate readily further expansion to allow for this, the area alongside was purchased prior to the design of the factory.

In the past we have pointed out the dangers of over-specialisation and, for example, the over-dependence of the industry on television sales, but Inductance Specialists, it would appear, have little to fear on this account, as in addition to large production runs for outside manufacturers, they have a healthy stock line of R.F. coils and transformers, their filter section and 7 and 10m/m miniature transistor coils and relays plus the expanding metalwork department. Many other of the smaller companies in the industry would do well to take their cameras to 1277 Cameron Road, as we did.

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BOOK REVIEWS

by I. H. S.

"Principles of Television Engineering" by Roy C. Whitehead, A.M.I.E.E., published in 2 volumes by Iliffe Books Ltd., London.

These two books are intended to provide a wide but relatively thorough coverage of television engineering for all those studying or engaged in television receiver servicing, television broadcasting, or industrial closed circuit installation or maintenance.

The emphasis has been placed on the nature of a television signal, how it comes to have its particular form, and how this signal is generated, radiated or distributed through cable circuits, then received and reproduced.

The treatment assumes that the reader has a basic knowledge of electronic principles and circuitry and understands sound broadcasting, cathode ray tubes, and their operation. On the mathematics side, little more than a knowledge of simple algebra and the elements of calculus have been assumed.

The first volume commences with a consideration of light, photo-electric circuits, and the synthesis of a picture signal. The author then deals with scanning techniques, aspect ratios, the spectra of video and R.F. signals, and gamma — the relation between signal output and light input. Other topics treated are, blanking and synchronisation, gating, and video mixing.

The second volume opens with a study of the studio equipment, and the various techniques used in programme mixing, telecine, tele-recording, magnetic recording and reproduction, and conversion of one television standard to another — a matter of some importance in view of the success of the satellite relay systems. More specialised material such as vestigial sideband modulation, and detection are next covered, before the subject of transmission via cable, with the attendant problems of equalisation and attenuation are dealt with.

After a chapter on transmitters, modulation systems and the combination of sound and vision signals, three chapters are devoted to various important aspects of receiving equipment. Aerial systems, the parts of the receiver, before and after the vision detector are all treated successfully, although not in great detail.

The final chapter, a long one, of some 70 pages, discusses in detail various kinds of video amplifiers.

The volume concludes by dealing in 6 appendices with details of C.R. combinations, D.C. restoration, power supplies, stabilised supplies, and camera tubes.

Both volumes have satisfactory indexes, the drawing and diagrams are well presented, but it is felt that the contents really deserve a hard cover as it is likely that these books will be in demand for reference purposes long after their use as a teaching device has ceased.

Our copy direct from and by courtesy of the publisher.

"The Radio Amateur's V.H.F. Manual", by Edward P. Tilton, WIHDQ., published by the American Radio Relay League Inc., Connecticut, U.S.A.

This long awaited book will fill a gap in the family of A.R.R.L. publications on various specialised sections of the art of amateur radio. Ed. Tilton probably has written more than any other person on the subject of amateur communication in the "ultra-highs" — the frequencies above 50 megacycles.

One important point must be made. This book is **not** just a collection of Mr. Tilton's articles, written over the years, combined into one book: It is a collection of some of his best articles improved and re-written where necessary to bring them up to date, together with a great amount of absolutely new material.

WIHDQ has the happy knack of writing a text about a specialised field in a language equally acceptable to both the beginner and the experienced V.H.F. worker. The book opens with an authentic history of amateur V.H.F. and then progresses through receivers, receiving techniques, transmitters, antennae and test equipment in a thorough manner. Practical constructional information is interlaced with important reference material, design data, circuits, photographs, formulae, graphs, and every chapter carries an extensive bibliography

Continued on page 34

SERVICEMAN'S COLUMN

Continued from page 25

of dual stylii fitted with two tips on the one shank it would mean the fitting of the appropriate tips by the stylus manufacturer. If this were done it would then be possible to dispense with the composite .0007'' stylus as well as the 78.

It is surprising that overseas manufacturers still continue to fit the latest stereo units with 78 "needles". Certainly the manufacture of 78 records continued in Britain for some years after it had ceased in this country but even so surely the advent of stereo would have been an ideal time to dispense with the 78 stylus in new equipment.

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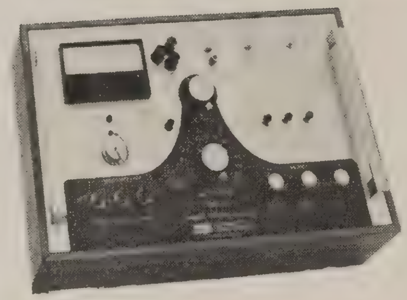

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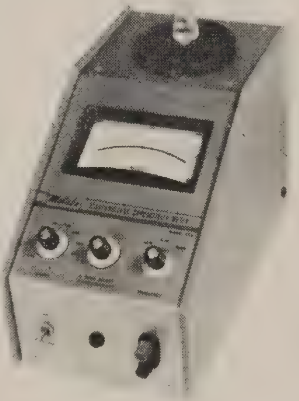

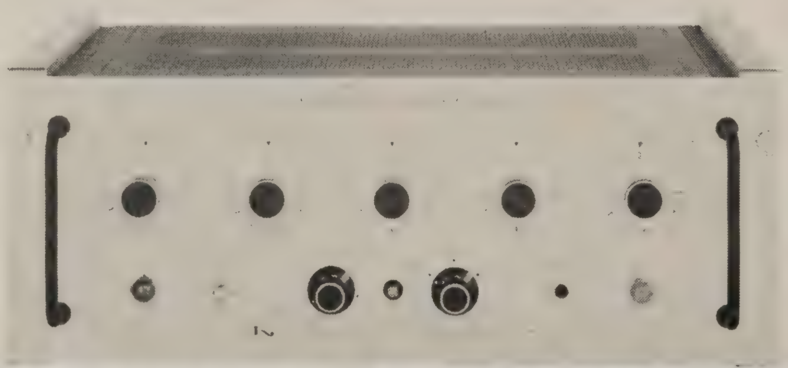

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Mobile Communications

Part V

by Countryman

Somebody once said, that engineering was 90% people, by which he meant that the purposes of engineering were essentially human purposes. In the mobile radio field, and indeed in the whole field of radio we can sum this up in the phrase ''customer satisfaction''. Many technicians tend to regard the customer, if they regard him at all, as someone who is kept out of the way by the sales staff, and if he should happen to find his way into the workshop, then the proper course is to blind him with science, and convince him that radio is far too technical a matter to be discussed with a person of his low mental calibre. If you think this is very exaggerated, check your own reactions the next time someone walks in and starts asking silly questions!

A lot of technicians take up the attitude of despising the salesmen because they cannot talk amps and volts, an attitude which is not justified since without the salesmen there would not be many mobiles being sold and they would be out of a job. What I am leading up to is the idea that selling, or at least advising the customer on mobile gear is really the job of a technician. Not, let me hasten to say, that man on the bench, who will be far too busy anyway, but to more experienced senior technician, whose knowledge of the operational aspects of mobile work is extensive and varied. Many, perhaps the majority of technicians will turn up their noses at the idea, because they get their principal satisfaction from wrestling with recalcitrant equipment. There comes a time in the life of most technicians, however, when the thought of tackling yet another dirty radio from someone's taxi brings little joy. It is at this stage of his career that the technician is ready to consider branching out into fields where he can get greater satisfaction, and it is here that he is ready to graduate to the ranks of ''sales engineers'' where his job as adviser to both the customer and the manufacturer will make use of his experience and technical knowledge. He is able to advise the customer of the best type of equipment for his job, advise on methods of installation, train operators in its correct use, and perhaps must important advise the customer on what his radio will and will not do. He will also do the important job of liaison between the customer and the manufacturer.

All too often I come across cases where the user is thoroughly dissatisfied with his radiotelephone set. Almost invariably the set is well maintained, and the installation has been well done, but somewhere along the line the customer has lost confidence in his equipment. Far too often it is because he has been sold a bill of goods by someone who knew no better, or knowing better, could not see beyond a quick sale to the fact that the customer needed good advice first. In the long term the result is damage to the business reputation of the firm involved, and another customer lost to radiotelephone.

This tendency to oversell equipment is fairly widespread. Many of you will remember when Citizens Band equipment first came on the market. Most advertisements talked about ranges of 10 miles. This is one of those statements that is true in the absolute sense, but needs to be qualified fairly heavily. You can work up to ten miles with CB sets in favourable conditions, but on the average the range will be a good deal less, in fact about a mile frequently represents the usable distance. Is this a disadvantage? Only if you have been sold the sets on the understanding that they will work ten miles. I know of many CB sets being used to excellent advantage over ranges of about a mile. The users are pleased with them and are always wanting more. Such uses are in firefighting, surveying, railway track and signal work, and bridgebuilding. The ranges vary from about 50yds. to a mile or so and in most cases there is no other way to do the job, and these sets fill the gap between larger long range portables and the unaided human voice. In bridgebuilding, for instance the river may be only a few feet wide, but if it is a swift mountain stream then the noise will make it impossible to carry out even a shouted conversation across it. The officer in charge of the building has then no option but to spend his time making cold, time consuming and hazardous trips back and forward across the river to pass his instructions. The CB set here would be worth its weight in gold, literally, over the course of a year's operations!

In all the cases quoted, the technicians who have issued the sets have been at pains to investigate the use intended, and have been sure that the non technical user is thoroughly aware of the limitations of the set. The result of this is that he comes back highly delighted with the results. Pleased because he has been able to do better than promised, not complaining because he cannot get the 10 miles quoted in the blurb.

What I have been trying to put across is the idea that giving the potential customer good advice is as much a technicians job as installing or repairing a set. Telling the maker where and how his sets are failing to meet the requirements is more important than modifying it in your own workshop as a ''one off'' job. After all others may be having the same trouble, but may not have found the solution. In the short term the effort of examining the customers requirement, giving him the correct advice and making a thorough job of the installation, **and** backing it up with operator training and supervision may be both costly and time consuming, but in the long run it will pay handsome dividends.

It is only when every radiotelephone installation is the subject of a thorough engineering effort from inception right through to after-sales service that it and its technical people will take a recognised place in the rapidly expanding field of telecommunications in N.Z.

LISTENING POST

by michael lawrence

All times are in GMT and frequencies in kilocycles.

With the advent of the New Zealand summer, reception in the higher shortwave bands should improve considerably, especially at night time. Many broadcasting organisations are taking advantage of this and, according to the International Frequency Registration Board, about 30% more stations will be using the 21 Mc/s band during the summer than last winter. Already transmissions in this band from such stations as the BBC are being heard at fair strength between 0900 and 1200 GMT, whereas a couple of months ago, they were completely inaudible. However, because of the still very low sunspot number, it will be several years yet before reception will be possible as high as 25 Mc/s.

The improved summer reception at night has allowed the BBC to retime the Pacific Service, beamed to Australia and New Zealand, to 0800 - 0845. This change came into effect on the 3rd October and the frequencies for this broadcast are 11955, 9640 and 7150. These same frequencies are also beamed to N.Z. between 0600 and 0800 when they carry the BBC World Service.

OTHER STATION NEWS

AUSTRALIA: Incorporated in the normal South East Asia service from Radio Australia each day is a special programme for the Australian and N.Z. Armed Forces in that area. The programme at 2300 GMT consists of 15 minutes of Australian news and N.Z. news supplied by the NZBC, followed by a request session. Frequencies in use at this time are 15220 and 15240.

ETHIOPIA. Station ETLF at Addis Ababa broadcasts in English from 1545 - 1600 on 6010 but suffers severe interference from Rome on the same frequency. The next transmission from 1630 - 1645 on 9765 is relatively free from interference but has weak signal strength.

FRANCE. A Russian broadcast from O.R.T.F. can be heard from 1600 - 1700 on 7160, 9620 and 11885. The 9 Mc/s outlet provides best reception in New Zealand.

GERMAN DEMOCRATIC REPUBLIC. Radio Berlin International's English language broadcasts to South East Asia are transmitted as follows: 0700 - 0730 on 15240; 1200 - 1300 on 15240 and 11795; 1400 - 1500 on 15240 and 1530 - 1600 on 11795.

GERMAN FEDERAL REPUBLIC. The current transmissions of Deutsche Welle beamed to N.Z. are heard from 0845 - 0940 on 15275, 11925 and 9640 and from 2110 - 2200 on 9530 and 7175.

GREAT BRITAIN. The best frequencies at the present time for reception of the BBC World Service are as follows: 0000 - 0330 11750; 0330 - 0400 9410; 0400 - 0600 9580; 0600 - 0800 9640; 0900 - 1400 15070; 1400 - 2000 12095; 2000 - 2245 11820 and 2245 - 2400 11750.

INDONESIA. The Voice of Indonesia at Djakarta provides a good signal on 9585 when it transmits a programme in English at 1430.

NORWAY. The Far East and Pacific transmission from Radio Norway at 0745 can be heard on 11850.

PAKISTAN. An English news bulletin is broadcast from Radio Pakistan from 0810 - 0820 on 17750. Before this time the transmission is in Bengali.

Another English broadcast, beamed to the English Isles and Europe, can be heard from 1945 - 2030. The 11672 outlet for this transmission is of good strength but suffers adjacent channel interference from telegraph stations and, the other frequency of 9615, is generally unusable because of broadcast station interference.

RUMANIA. Radio Bucharest broadcasts its third daily English language transmission to North America from 0430 - 0500 on 11940, 11810, 9590, 9570, 9510, 6190 and 6150.

UNITED NATIONS. The United Nations Radio transmits a 15 minute programme to N.Z. at 0730 from Tuesday to Saturday on 11830 and 9665. This same programme is repeated from a Honolulu transmitter at 0845 on 11775.

U.S.S.R. At 0500 Radio Moscow broadcasts to North America in English. Frequencies in use at this time are 9670, 7360, 7320, 7310, 7290, 7180, and 7150.

Radio Tashkent's English transmissions between 1200 and 1230, 1400 and 1430 are broadcast on 9600 and 11925.

JAPAN. Radio Japan transmits to Australia and New Zealand from 0930 - 1030 in English on 11875 and 15235.

BOOK REVIEWS

Continued from page 31

for further reading. The book is up to date, and semiconductor techniques are, where applicable, recommended, particularly in the new and interesting field of parametric amplifiers and varactor multipliers.

In the foreword, Ed. Tilton records his appreciation for the contributions made by others of fame in the V.H.F. world—names such as M. F. De Maw, F. S. Harris, and W. C. Taft.

This 300 page book then, is one largely about things that work, and the principles that make them work — the best of the distillation of a generation of practical experience in the realm of V.H.F. The reviewer's only complaint is that it could have been twice as big — then it would have cost more — but it would have been worth it.

NEW BOOKS

We have on hand a large number of books from different overseas publishers. We hope over the next two or three months to bring our readers up to date with these most recent releases by giving more regular coverage to them.

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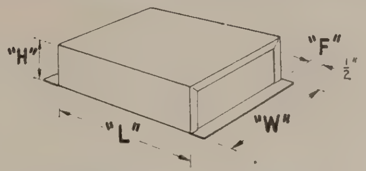

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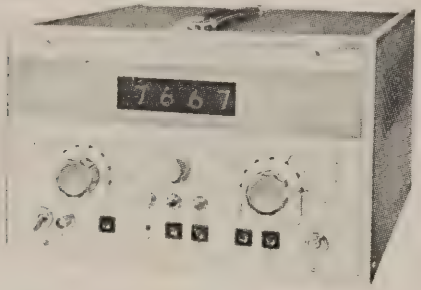
New Products

NEW LOW-COST 5 Mc/s TIMER COUNTER

Direct frequency measurement in excess of 5 Mc/s is an outstanding feature of the specification of this new TC4 timer counter.



Four gate times and seven timing units from 1uSecond to 1 Second enable accurate measurements to be made of frequency, period and time. The instrument has a four-digit in-line display with a decimal point automatically positioned in Kc/s for frequency measurement. The period facility (up to 10^5 periods) permits accurate measurements of extremely low frequencies.

For time and frequency measurements the basic accuracy of the TC4 is governed by an oven controlled crystal oscillator set to one part in 10^6 at ambient temperature. Should even greater accuracy be required, an external standard producing sinusoidal or pulse signals can also be used. The U.K. price is £225.

ENQUIRY 202

TRANSISTORISED TELEVISION BOOSTER

Designed to boost weak signals and to overcome losses in antennae feeding up to four television receivers in poor signal areas, this transistorised booster features high gain, low noise figure, optional signal splitting and built-in lightning protection. It is clamp-mounted on the aerial boom near aerial terminals. The booster has a corrosion proof case and operates direct from 240 a.c. supply.

A specification is:
240V a.c. model: 240 volts, power consumption 1 watt.
Construction: Two units, one masthead unit containing transistor amplifier, one remote power supply with built-in four-way splitter.
Impedance: Input and output 300 ohms.
Gain: H/B 15 db L/B 19.5 db.
Noise Figure: H/B 3.7 db. L/B 3.2 db.

ENQUIRY 217

* * *

COMPUTER TRANSLATES ENGLISH INTO BRAILLE

An electronic computer is now translating English into Braille at a rate of more than 1,000 words per minute. The computer translation programme developed by company mathematicians in conjunction with the American Printing House for the Blind in Louisville, Kentucky employs the complex rules of Braille usage to convert English into the 246 characters of Grade II Braille. These characters — combinations of six raised dots — represent the alphabet, numbers and punctuation, as well as 183 special contractions and abbreviations.

Texts to be translated by the computer are first reproduced on punched cards. The computer converts the text into Braille, and first produces a printed page with Braille characters matched to the English equivalent.

After this page is proof-read for accuracy, the computer produces a set of punched cards which are then used to operate a Stereograph which in turn produces the embossed plates from which Braille pages are prepared.

One of the most time-consuming operations in the production of Braille literature has, in the past, been the proofreading and correction of translation errors in the Braille plate. The new computer process virtually eliminates proofreading and subsequent corrections.

ENQUIRY 210

* * *

LONDON RADIOTELEPHONE SERVICE OPENS

The British G.P.O. has inaugurated its first radiotelephone service in the London area. Normal telephone calls can now be made both ways between a motor car in the London area and any area in the world with a telephone service.

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SEPTEMBER, 1965

FLOATING MILLIVOLTMETER WITH AMPLIFIER OUTPUT

A new millivoltmeter for the wide frequency range from 10 c/s to 1 Mc/s has been developed by Rohde & Schwarz. Its sensitivity is about 1 mV at full scale deflection. The range of measurement extends up to 300 V. An outstanding feature of the instrument, which carries the type number UVN, is an "off-earth" amplifier layout and amplifier output. Its "off-earth" feature makes it suitable for all measuring problems in which the potential of the test signals differs from the potential to earth. The common-mode rejection is better than 120 dB at an interfering frequency of 50 c/s.

The amplifier output offers the possibility of using the millivoltmeter as a sensitive preamplifier, for example, for oscilloscopes or of connection to an oscilloscope in order to check the wave form of the voltage under test. Thanks to its special input arrangement and using an attenuator probe the instrument may also be employed for high-impedance, low-capacity measurements, say, on tuned circuits. A highly stable square-wave generator is incorporated in the instrument for checking the entire amplifier. This facility permits any deviations from the rated gain of the set to be directly read on the panel meter.

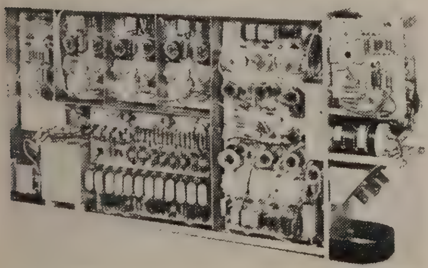
The new millivoltmeter is fully transistorized and is suited for AC-supply or for battery operation. A nickel-cadmium storage battery is trickle-charged by a stabilized power supply.

ENQUIRY 205

* * *

SOLID STATE AUTOMATIC DIRECTION FINDER

Aviation authorities were recently shown the Marconi Automatic Direction Finder, type AD370. No mechanical switches or tuning condensers are employed in this receiver development which covers three frequency bands in the range 190 - 1799.5 Kc/s. Solid state tuning is performed by Varactor diodes and switching is done by diodes. The complete elimination of mechanical parts from the system increases reliability. In the case of the AD370, the "Mean Time Between Failure" is estimated to be greater than 3,000 hours.



ENQUIRY 197

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NEW DITHER-TUNED MAGNETRON

A new magnetron, with electromechanical dither tuning, for airborne radar systems is now available. The new tube, the WX–4742, provides narrow-band frequency diversity at high pulse power, and is said to do this with reduced size and cost compared to magnetrons having hydraulic or spin tuning.

The new tube is mechanically tunable from 8.5 to 9.6 gigacycles and has an electromechanical dither-tuning range of ±10 megacycles throughout the magnetron's band. This improves target definition, enhances system performance, and enables high-performance operation in a military airborne environment.

Peak power output of the magnetron is 200 kilowatts. The tube has a 0.001 duty cycle at 22 kilovolts and 27.5 amperes. The current required by the dither drive is one ampere; its load is 0.2 ohm. The new WX–4742 magnetron replaces, both mechanically and electrically, the existing magnetron type WX–7111.

ENQUIRY 204

* * *

RECTIFIER DIODES

In addition to a complete radio and television tube line, a German company is offering a number of different rectifier diodes for this field. The high voltage cartridge type selenium rectifiers of the TV series have aroused considerable interest. TV 6.5 (6.6 mm diameter, 57 mm length) and TV 11 (6.6 mm diameter, 85 mm length) are designed for pulsed voltage operation with a voltage of 7.5 and 12.65 Kvss, respectively, yielding d-c voltages of 6.5 and 11 Kv, respectively, at 0.2 ma current. These rectiers are without sockets and heaters-permitting more elegant design—and this feature makes them extremely useful for high voltage generation in portable transistor or tube television receivers, and for generating the focusing voltage in colour picture tubes.

The moulded selenium rectifier stack B 250 C 100 replacing five different flat and stack rectifiers has become very popular due to its high technical qualities and favourable price, and is now the preferred rectifier in radio receivers.

The silicon bridge rectifier B 40 C 2200 has optimum characteristics for use in transistorised television sets. Its four silicon elements are resin-moulded into a plastic case of dimensions 40 mm x 10 mm x 20 mm. The rectifier can sustain a d-c current of 2.2 a without heat sink, and a d-c current of 3.2 a when a heat sink is provided, by clip-mounting it on a chassis.

ENQUIRY 193

* * *

NEW MICROWAVE SWITCHES

Three additional coaxial single pole single throw switches to complete a family of broadband, high isolation microwave switch/attenuator/modulator units have been announced by Hewlett Packard.

The -hpa-3500 series is ideal for such applications as ECM receiver switching and low power antenna switching in phased arrays. As variable attenuators, they can be used for power levelling and signal modulation applications.

The -hpa- 3503, 3504, and 3505 microwave switches, as well as the previously announced -hpa-3501, operate over the range 500 Mc to 12.4 gc with isolation minima ranging from 25 db at 500 Mc to 45 db at 12.4 gc. Insertion loss of all units at 500 Mc is 0.4 db maximum and at 12.4 gc is 1.5 db maximum.

The -hpa-3501 and 3503 are switched OFF with **positive** bias and the -hpa-3504 and 3505 are switched OFF with **negative** bias. The bias terminal on all four units is BNC. The RF terminal on the -hpa-3501 and 3504 is TNC and on the -hpa-3503 and 3505 is Type N.

The availability of alternate RF connectors and bias polarities provides the circuit designer significant flexibility of choice in switching, attenuation, and modulation applications.

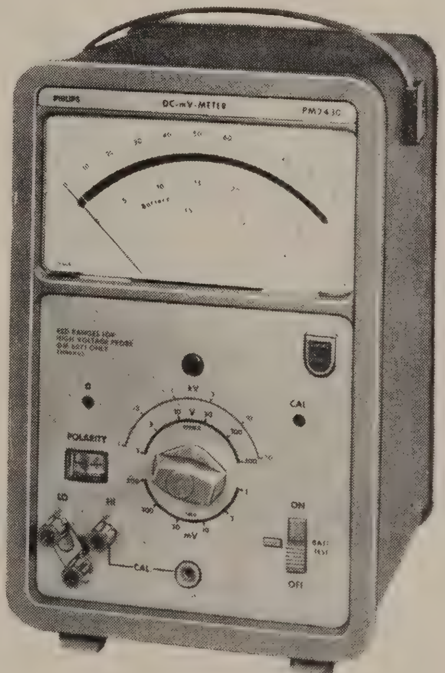
Size is 1 1/16" x 1" x ¾".

ENQUIRY 198

* * *

BATTERY OPERATED D.C. MILLIVOLTMETER

Latest addition to the Philips range of electronic voltmeters is the PM 2430, a compact, fully transistorised, millivoltmeter for d.c. measurements. The instrument is battery operated, thus being independent of mains fluctuations, and has the added advantage of a floating input.



The measuring range is from 1 mV (full scale) to 300 V, and with an optionally available E.H.T. probe, up to 30 kV. Accuracy is 2% of full scale deflection. Pre-deflection is less than 2½% of full scale in the most sensitive range. Polarity of the voltage is automatically indicated on a small meter which can also be used as a null indicator with a sensitivity of approximately 5μV. Input impedance is 1MΩ from 1mV, and 100 MΩ from 1V to 300V.

In common with all Philips voltmeters the PM 2430 has an internal calibration voltage for easy re-adjustment, without the use of additional instruments. Power is supplied by four dry cells of 1.5V each or NiCd cells; the latter have a life of 50 hours per recharge up to 300 recharging cycles. The PM 2430 measures 9½" x 6½" x 7" and weighs 7 lb.

ENQUIRY 214

ENQUIRY CARD AD. 21

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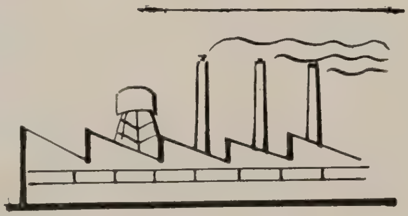

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PROTECTION FROM IMPLOSION FOR TV TUBES

A new lost-cost implosion-protection system for television picture tubes is now being used by an American concern. Called the Welband system, this protection is available at present only with smaller tubes.

The system eliminates metal shells, contoured metal rim bands, and the expensive epoxy potting resins or plastic sheets on the face of the picture tube. Instead, the Welband system requires only a steel tension band and a strip of plastic tape.

Two newly developed picture tubes—one 12-inch and the other 11-inch—were first to use the system. These new picture tubes feature a flatter face, square corners, and improved black-to-white contrast. The greater flatness of the tube face shortens the over-all depth of the television set. In addition, the hard glass surface of the exposed tube face is not susceptible to the objectionable scratches found on most plastic-covered tube faces.

High and low video-drive-voltage tube versions are available. Further savings in circuit cost can be realized by using the very low video-drive-voltage version which operates on only 30 volts. Heater ratings suitable for series or parallel usage are available at 6.3 volts with 600, 450, or 300 milli-amperes heater current.

ENQUIRY 194

NEW RANGE OF SEMICONDUCTOR PRODUCTS

The HPA 4104 light source utilises a gallium arsenide injection luminescent diode in a package with a fibre optic light pipe. The device provides a narrow spectral band of infrared radiation, which can be electrically modulated at nano-second rates. The output surface of the HPA 4104 has an effective "window" diameter of .02 in. through which 0.1 mw of I.R. Energy can be radiated. The device is intended to operate at room temperature.

The HPA 4105 is a similar device in a TO-18 package. In this device the I.R. radiation source is a spot .02 in. in diameter located .068 ins. behind a .12 in. diameter flat glass window. This device also operates at room temperature.

Some applications of the 4104 and 4105 are the response and intensity testing of optical sensors and computer card reading. The HPA 4104 can be used in conjunction with the HPA 4201 Photodiode, and the HPA 4105 can be used in conjunction with the HPA 4203.

The HPA 4201, and 4203 are Silicon P.I.N. Photodiodes designed as ultrafast light detectors for use in the visible and near-visible I.R. region. The 4021 utilises a fibre optic light guide to enhance the utilisation flexibility and simultaneously reduce the sensitivity to capacitively coupled extraneous signals. The sensitivity area of the 4201 is circular with a diameter of .02 in. In the case of the 4203 the sensitive area is located .068 in. behind a window similar to the HPA 4105.

Both the 4201 and 4203 have a quantum efficiency of about 0.5 over a spectral region with a wavelength of 6000 A to 10,000 A. This efficiency remains essentially constant over 6 decades of input optical flux. When employed with an appropriate 50 ohm termination the response is essentially flat from DC to IGC. The 4201 and 4203 require reverse voltages of 20 volts to deplete the 1 region of carriers. At voltages above this, the capacitance of the device remains constant at 2 pf. and the photo-generated carriers are swept out of the diodes in less than 1 nano-second. Applications for both the 4201 and 4203 include fast light pulse detectors in the nuclear and semiconductor fields.

ENQUIRY 216

* * *

NEW 10-INCH CATHODE-RAY TUBE

A new 10-inch cathode-ray tube, for use in numerous industrial and military applications requiring high resolution, is now available. Photographic recordings and alphanumeric displays are included among its many uses.

The WX30176 is capable of tracing a 0.002-inch line width over the entire screen. Auxiliary deflection plates permit small amplitude deflection of the electron beam independently of the normal magnetic scanning.

The round, flat-faced tube is aluminized, and can be supplied with most of the JEDEC registered phosphors.

ENQUIRY 177

ENQUIRY CARD AD. 22

PHILIPS

YOU CAN BUILD YOUR OWN TV. RECEIVER

Your own T.V. receiver built to the best professional standards. Features printed wiring board which already solves your layout and connection difficulties, the critical EHT unit is pre-wired. Comprehensive manual describes assembly in detail and coloured circuit simplifies wiring layout.

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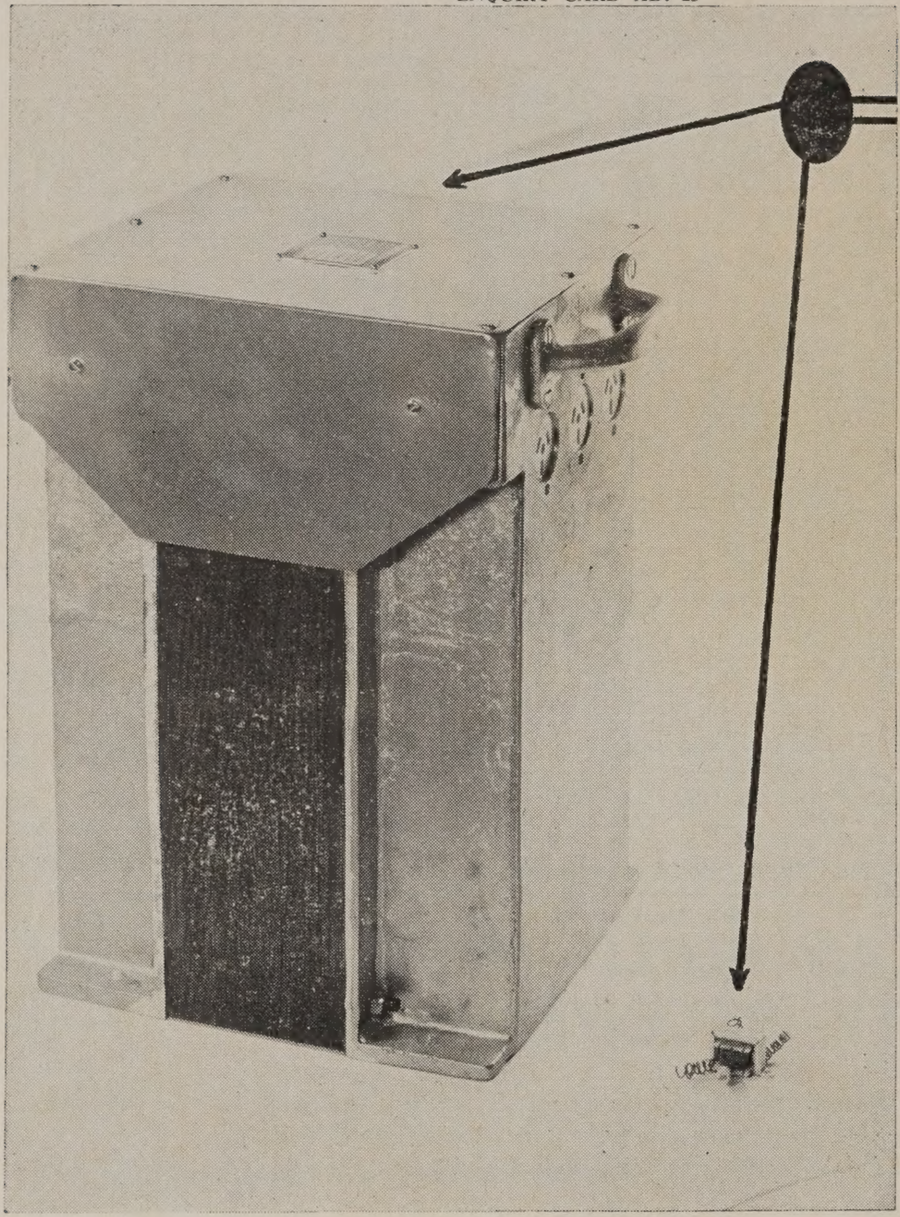

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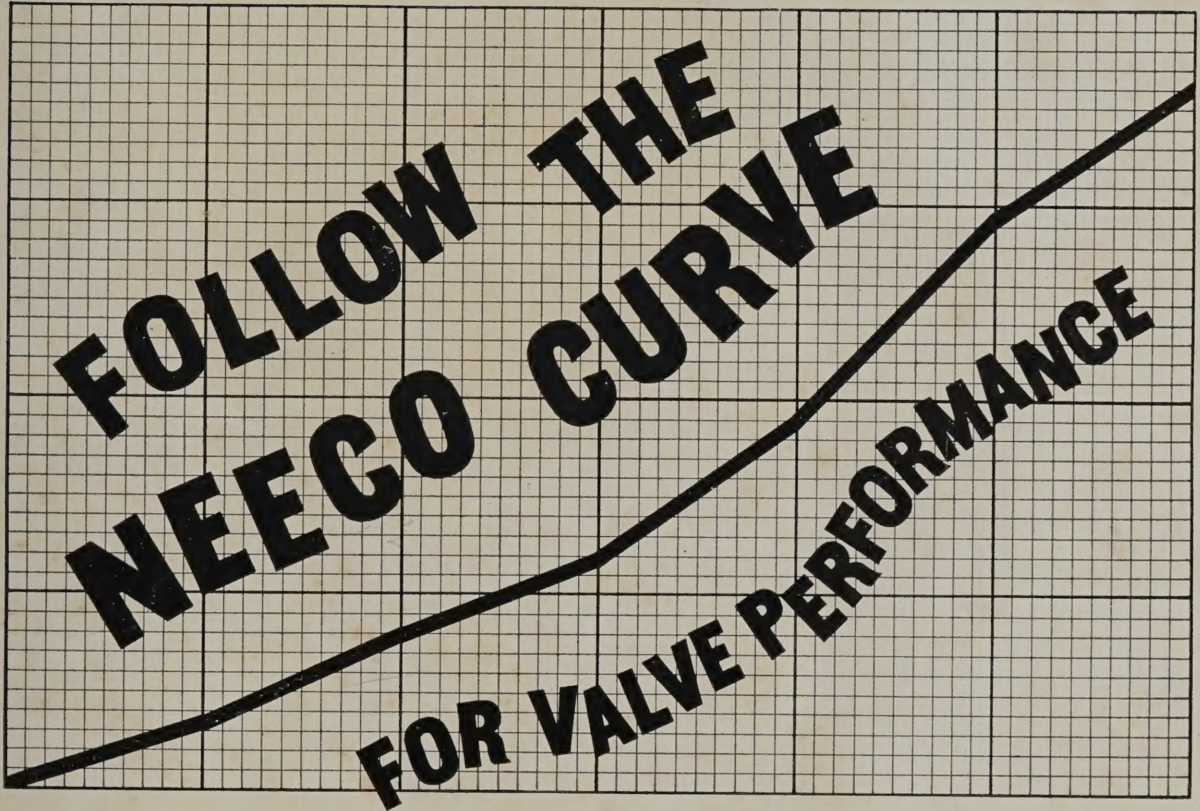

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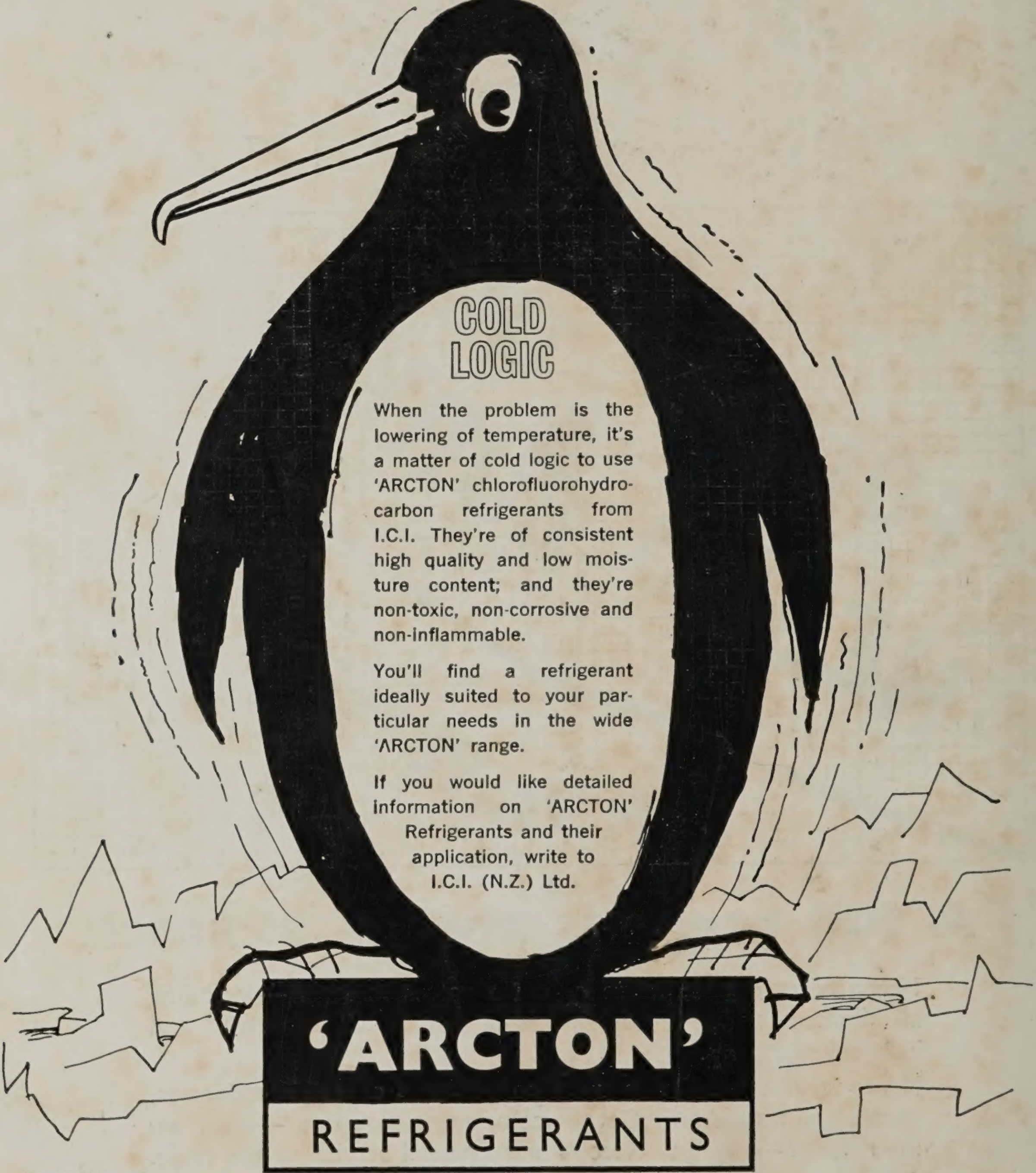

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